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JOSEPH WETZLER.

It is with deep regret that we record in this issue the death of a former editor of this journal, Mr. Joseph Wetzler, a personal and intimate friend of many to whom this will be the first sad news that he has passed from among us. A man of many natural gifts, of high culture and strong convictions, Mr. Wetzler gave half his life and his best years to electrical journalism and was one of the personal forces that helped make the *Electrical World* what it is to-day, a decade after he left the editorial ranks. We desire to take this opportunity of laying thus on his untimely grave our tribute of esteem and admiration.

WIDESPREAD WELFARE WORK.

The reports of the public policy committee of the National Electric Light Association have of late years commanded a large amount of attention, chiefly from the importance of the subjects discussed and the breadth of view indicated by the treatment. Through such reports, for example, the association was early on record in favor of the physical valuation of public utilities as part of the basis of rates, and in favor of the indeterminate franchise as against the old form of a limited one, preferring to lay the emphasis on good behavior rather than a hard-driven bargain. The report of last year was a document peculiarly entitled to high praise and one which will probably long be distinctive as the starting point in the "welfare work" that is now engaging the attention of the association officers. Few society publications of such a character reach this office, and we cannot but feel that if there were more of them, breathing the best ideals and statesmanship of the time, the social problems connected with capital and labor would be most appreciably lessened.

Last year the association sent an expert abroad to investigate welfare work in general in England and Germany, and the committee report embodied some fundamental principles and data on the subject. It is now announced, as will have been noted from our columns, that the public policy committee of this year is dealing boldly with a whole program which embraces accident and sickness insurance, profit sharing by employees and the payment of annuities for long and meritorious service. When it is remembered that the association has some 1200 corporations in its membership and embraces at least 90 per cent of the investment and earnings in the central-station industry, the significance of such work cannot be overestimated.

The report, to be presented we presume at the New York convention three months hence, will be awaited with keenest interest, for it is obvious that if reasonable and logical, as may be expected, it will have an influence far outside the field it is intended to cover. There will be many and valid reasons why all the corporations should not adopt all the suggestions, often

because a good start has already been made in one or another direction. But, as this journal knows full well, even when we cannot effect immediately a desired change, it is something accomplished to set men thinking and to apply the right stimulus. It is also worth while for an industry as thus organized to be in advance of public opinion rather than to follow it reluctantly and coerced. To-day we are all of us far more socialistic than we know, and it is time that we learned the difference between destructive and constructive socialism. The latter is a worthy aim of the association when it seeks to make every employee a faithful partner in the business. Such aims as this, like the other efforts to promote real conservation of national resources and to lessen the dangers from electrical shock, are a fitting and proper part of the work of the association, deserving universal commendation.

SOME POSSIBILITIES OF SUMMER LOAD.

This is the annual season at which we feel impelled to stir up our central-station friends as to the desirability of acquiring a heating and cooking load to comfort them during the dreary summer months when there is comparatively little doing in the lighting business. Considering the fact that electric cooking devices and electric heaters are now in a very satisfactory practical state, and that over a large part of the country electricity is easily available, it is most extraordinary that greater progress has not been made in this line of business. Electric heating, of course, cannot compete with other methods during the winter months when heat has to be used continuously except at very low cost for energy. Between seasons, however, and all the year round in special cases. it can be profitably worked at a figure which would be unquestionably remunerative to the majority of stations. Central stations make no outcry against taking motor load at figures very much below the customary lighting schedule and should not hesitate to take on heating and cooking load upon a similar basis of price, for heating and cooking furnish an off-the-peak load of a character intrinsically very desirable.

Motor service almost inevitably furnishes a considerable lap load at the time of the afternoon peak in spite of all efforts to the contrary. The heating and cooking load, on the other hand, comes on only as the peak is falling off, and from this standpoint is rather more than less desirable than motor load of similar amount. A good many central stations make prices as low as from 5 cents to even a little less than 3 cents per kw-hour for heating and cooking service, and business thus acquired represents a not inconsiderable amount of clear gain. At 5 cents per kw-hour a good deal of cooking business can be taken on. At 4 cents or 3 cents a considerably larger amount would be available, and near the lower figure electricity for auxiliary heating becomes feasible. The critical price for the large development of this sort of business seems to be in the neighborhood of 3 cents per kw-hour. In a few instances cooking apparatus has been taken on on a flat rate, as at Hartford, Conn., but most supply companies rather look askance at this proposition. Metered energy, however, at 3 cents to 5 cents per kw-hour could certainly be furnished in many cities to very great advantage and in large amounts, even where there is vigorous competition from gas. There is no intrinsic reason why the electric range should not become as common an article as the gas range, provided the supply companies are willing to make a suitable figure for this class of load in consideration of its being off the peak and out of season. But it is quite futile to exploit heating and cooking devices at ordinary rates in the face of competition from gas. If a flat-rate basis is not feasible, then separate metering is the logical course to follow. A group of electric heaters and electric ranges can be made quite as remunerative as a group of small motors, and there is no reason why the latter should have any monopoly of low prices and special meters.

THE NEW FLAT-RATE CAMPAIGN.

It is instructive to note how considerable interest has been aroused in the flat-rate system for residence lighting similar to that inaugurated some time since in Hartford. At the present time some thirty or forty companies have fallen into line and are taking on residence lighting under contract at a fixed price per lamp per month, with some device to protect the station against demand larger than that contracted for. The price varies somewhat from place to place, but seems commonly to be based on about 1 cent per watt per month for the contract demand. In all cases tungsten lamps are employed, and in some instances renewals are free, while in others the cost of renewals is put upon the customer as a species of guarantee against excessive burning hours, for which it is probably not ineffective. The interesting part of the proposition from the central-station standpoint is that it has given every evidence of paying. In fact, there is good reason to believe that the load so taken pays quite as well as that secured on the ordinary meter basis, everything considered. The records so far available show that the average use of the contract load is less than four hours per day, and since at the usual rate the price paid is in the neighborhood of $120 per kilowatt per year, it will readily be seen that the prospect for returns at a fair price is excellent. There is this difference, however, between the contract load and the meter load, that in the former case the customer knows exactly what he is going to pay and the payment is the same for every month; so that the usual apparently heavy bills for the winter months do not appear, although they are made up for by the extra payments during the summer.

Psychologically the flat rate seems to have the advantage even at substantially equal price, and thus far there has been comparatively little complaint of any attempt on the part of the customers to beat the game by various devious methods. Of course, there are times when the limitation of demand is inconvenient, especially in houses equipped with many lamps as a matter of convenience, in which on special occasions the load might naturally run high. Practically, of course, this difficulty can be met, as it has been in some cities using the maximum demand indicator, by allowing the indicator to be put out of circuit, say, one night a month on previous notice to the company. A concession of this kind on the flat-rate system would cost the company very little and would obviate any practical trouble from the cause mentioned. Besides this, it is, of course, a fact that comparatively large installations can be advantageously handled on the ordinary meter basis, and experience thus far has indicated that most of the load secured by the flat-rate scheme is in flats and residences, which either

would not furnish any business on a meter rate or would furnish it on comparatively an unremunerative basis. A large proportion of this contract load, where it has been obtained, is new business and business taken directly out of the clutches of the local gas company. After all is said and done, the gas companies manage to keep running and pay good dividends by relying very largely upon the aggregate of many small consumers. Electric supply companies can no longer afford to discourage this comparatively petty business, because it foots up to a considerable yearly total, and by a flat-rate scheme it can be obtained and kept.

CENTRAL-STATION ICE-MAKING.

In a canvass made from this office among central stations having ice-making auxiliaries, more detailed information of which is given on a following page, it is significant to note that 130 companies declared satisfaction with the results of combination ice and electric plant operation, twenty-four even taking occasion to express themselves enthusiastically on the subject, while only four reported discouragingly. Of special interest, too, is the fact that these favorable results were obtained among the smaller stations, principally in towns of less than 5000 population. When it is recalled that 70 per cent of the 6000 central stations of the country are in such communities of 5000 or less, the real magnitude of the profit-earning field thus opened to the small-plant operator during the light-load summer season begins to become apparent. It should be remembered, too, that central-station ice-making is to some extent conducted off the wastes of the purely electrical plant, and, as the reports of certain combination plants have revealed, the earnings of the ice equipment during only a few months of the year may match or exceed the whole annual return on the electrical apparatus. Ice-making may also render twenty-four-hour operation possible during light-load periods in instances where otherwise it could be conducted only at a loss. In the way of more broadly popularizing the use of electricity in the smaller electrically uneducated communities such twenty-four-hour service, therefore, means much during the heated season, when electric fans and irons are at a premium and prospective motor users are most susceptible.

Nor are artificial ice plants nearly so restricted in geographical distribution by climatic range or the competition of natural ice as is generally believed. Of course, the practical, profitable value of a combination ice plant is limited by the market for its product, and in many regions the demand for ice will not fully tax the by-product capacity of the central-station plant serving the same community with electricity. But artificial ice is purer and more sanitary than that naturally frozen, and the demand for such superior ice is subject to cultivation and increase until ice-using habits have been formed, much in the same way that the modern standards of illumination have been raised by the introduction of more nearly perfect illuminants. The announcement in these pages last week of the installation of several motor-driven compression plants in Minnesota, alongside Lake Albert Lea, where the ice crop never fails, shows that the cleaner, purer qualities of artificial ice need not fear competition from the natural product, even in north latitude 47 deg. The present investigation among central-station plants has been particularly illuminating in showing the number of ice-making stations in Oklahoma, Kansas and other States in the central West. In several of these the ratio of installations to population is not far below that found in certain Southern States where ice-electric operating conditions are supposed to be at their best. The facts thus point out that the combination-plant industry has tended to develop most extensively in new territories rather than especially in those States which are particularly arid in climate. Such plants should, therefore, be viewed as an evidence of general progressiveness and foresight, reflecting the general tendency in small cities of newly developed regions to install only the most modern and productive equipment. Given two towns or cities of equal size, one 50 or 100 years old and the other perhaps a tepee town ten years before, the younger community is likely to be far in advance in electrical plant and business methods, as in its buildings and public improvements, of its more ancient and conservative fellow. It is, therefore, due rather to this attitude of progressiveness that ice and electric plants exist in such numbers in the newly settled South and Southwestern States, and central-station students investigating the conditions under which combination plans operate successfully should not ascribe the remarkable results obtained in these new sections entirely to climatic conditions.

Ice-making will undoubtedly solve the problems of many small and struggling central stations whose summer loads are at present carried with indifferent financial success. Such plants are thus enabled to make more complete use of their exhaust steam, permitting one set of investment and operating costs to operate two profitable businesses. Even where an ice plant is already installed in a town the advantages of economy which the central station enjoys by reason of its combination operation enable it to put up effective competition to the existing ice factory. Office and plant forces can be employed to double advantage in the combined plant, the men who must be carried on the payroll over the slack periods being occupied profitably during the summer season in the ice plant. In larger cities it may be found that the special problems of the respective electric and ice-making businesses will require that they be conducted separately. But in the great majority of the central stations of the country—these 4700 odd, indeed, which are operated in towns of 5000 or less—ice-making seems likely to prove the solution of some of the grimmest of the small-plant managers' problems of operation. The significance of the field thus being opened is already being realized by central-station men and designing engineers, and ice-machinery manufacturers who intelligently grasp the opportunity and make a study of the special conditions in this field should profit largely. Heretofore small stations have been planned too frequently with the single idea of electrical generation, while the commercial advantages of by-product manufacture have been rather overlooked. Special study of the proper co-ordination of electric and ice-making equipment should provide a useful field for a number of combination-plant designing engineers, their technical recommendations being preceded, of course, by careful commercial investigation into the present and probable future ice demand. Each station in itself involves relatively small equipment, as plants go nowadays, but the aggregate import presented by nearly 5000 such stations cannot fail to receive proper recognition from the central-station industry, the designers of power plants and the manufacturers of machinery. At least 250 such plants already point the way to more successful central-station operation in small communities.

Licensing Professional Engineers.

Several bills have been introduced before the New York State Legislature prohibiting the practice of engineering by anyone unless so authorized by a license issued to him by a State board of engineering examiners. Laws to a similar effect have been passed in a few States and others are pending before a number of legistlatures. The bill at Albany which is being most strongly pressed resembles the law applying to State qualification for the practice of medicine. It is understood that the movement originally leading to the introduction of the bills at Albany was encouraged by certain labor unions.

At a meeting of the American Society of Civil Engineers on Jan. 18 the subject of the licensing laws was discussed at length in connection with a report of the board of directors recommending a model for a bill for presentation before legislatures which were committed to the passage of license acts From the discussion it appeared that the sentiment of the society is almost unanimous against the principle of licensing, but in view of the strong probability of that principle being enacted into law the board reported and the society approved the model bill submitted, with the understanding that it should be presented as a substitute for the bills on the subject brought before the legislature. As approved the model bill was accompanied by a resolution as follows:

"*Whereas* there are national societies of engineers in the United States membership in which can be secured only after rigid examination of the fitness of aplicants to practise as engineers; and

"*Whereas* the public has ample protection if it will employ only those who have thus demonstrated their ability; be it

"*Resolved*, That the board of directors of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any state; and be it further

"*Resolved*, That if, notwithstanding this, the legislature of any state deems the passage of a statute covering the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the board as embodying proper requirements for that purpose, is recommended."

A committee of the American Institute of Electrical Engineers has been appointed to consider the subject of the New York State bills, and that body will probably send representatives to Albany to oppose the bills at a hearing to be given the present week. At a meeting of the council of the American Institute of Consulting Engineers, held Feb. 24, it was decided to oppose all the bills now pending at Albany to license civil engineers, and the president, Mr. Boller, and the committee on legislation of the Institute were instructed to attend the hearings of these bills and to use all legitimate means to prevent their passage.

Public-Policy Work of the N. E. L. A.

Indications are that one of the most important and far-reaching reports ever made by the committee on public policy of the National Electric Light Association will be presented at the coming convention in New York City, May 29-June 3. Judging by the number of long sessions already held and others scheduled to be held, the recommendations of the committee, which is headed by Mr. C. L. Edgar of the Boston Edison company, will embody mature thought and study. The committee has sharply defined its work in order that it may be more effective. Neglecting the broad questions of public-service commissions, natural resources, rates, franchises, legislation, etc., thought has been concentrated on those vital points which affect the companies and the relations of their employees to them, all of which are broadly covered in what is generally termed welfare work. With a large number of the Edison companies contemplating or actually engaged in this work of human interest, and with governmental regulations and laws respecting employers' liability, it was felt that no more timely and important work could be undertaken by the committee this year. The vice-chairman of the public policy committee, Mr. Arthur Williams, of the New York Edison Company, spent some months abroad last year immediately after the St. Louis convention in a thorough investigation and study of welfare work and embodied much of his findings in a report on the subject before the Association of Edison Illuminating Companies. Doubtless some of the results of his investigations will also be reflected in the public-policy report this year. President Freeman has already launched a very broad profit-sharing-investment fund and pension system in Brooklyn, and Mr. Scovil's company in Cleveland has a profit-sharing arrangement with its employees. The Public Service Corporation of New Jersey recently announced a pension and benefit system, and investment funds are in vogue among a number of the larger lighting companies. The personel of the committee having the public-policy work of the N. E. L. A. in charge is as follows: Messrs. Charles L. Edgar, N. F. Brady, E. W. Burdett, H. M. Byllesby, Henry L. Doherty, George H. Harries, Samuel Insull, J. B. McCall, S. Scovil, Charles A. Stone, Arthur Williams. This is conceded to be the most important standing committee of the association.

British Decision in Favor of Marconi.

On Feb. 21 a decision was rendered by an English court upholding the validity of a patent granted to G. Marconi relating to the principle of wireless tuning. The English patent sustained corresponds to an American patent issued to Marconi (No. 763,772) dated June 28, 1904. The defendant was the British Radio-Telegraph & Telephone Company, and its defense against the charge of infringement was that the principle of the patent in suit was anticipated in an English patent issued to Braun in 1899. Among the experts who appeared during the proceedings and were examined in open court were Messrs W. D. Duddell, James Swinburne and C. Vernon Boys.

The defense claimed that Marconi was absolutely anticipated by Braun in "loose-coupling" tuning. The counsel for the plaintiff claimed that Mr. Marconi had conceived the desideratum of having a closed reservoir which should gently give out energy, and the idea of a reservoir circuit which should have a constant oscillation backward and forward of such character that the oscillations would only gradually be given out to the other circuit, so that it should persistently oscillate. There was not, he said, a trace of these principles in any document before the date of the Marconi patent; there was no hint about it in Lodge, and there was no "building up" in Lodge. The result of the resonance that one got by tuning everybody knew, but the one thing that people did not know was that connecting a closed reservoir with an open aerial and attuning these, apart from trying to tune the aerial in one to the aerial in the receiver, was in fact an application of a well-known method of tuning in a new way and for a new purpose.

The Marconi interests claim that the patent upheld covers the entire principle of wireless tuning. As described in the patent specifications, the invention consists in including in a wireless-telegraph system, at the transmission station, the combination, with an oscillation transformer of a kind suitable for the transmission of very rapidly alternating currents, of a persistent oscillator and a good radiator; one coil of the said transformer being connected between the aerial wire and earth and the other coil connected in circuit with a condenser, a producer of Hertzian oscillations in the form of a spark producer, and an induction coil (constituting the persistent oscillator) controlled by a signaling instrument. The complete system also includes at the receiving station an oscillation transformer, one coil whereof is included between the aerial receiving wire and earth, constituting a good absorber of electrical oscillations, while a device responsive to electric waves,

such as an imperfect contact or a device for operating the same, is included in the circuit with the other coil of said transformer. The system also requires at both stations the inclusion in the lines from the aerial conductor to the earth of variable inductances and the use at both stations of means for varying or adjusting the inductances of the two circuits at each station to accord with each other. The specification states that by this arrangement a perfect tuning of the apparatus is secured at a transmitting station and one or more of a number of receiving stations.

Western Union Award in Telephone Case Confirmed.

On Feb. 20 Judge Colt, of the United States Circuit Court, at Boston, confirmed the report of the master in the suit of the Western Union Telegraph Company against the American Bell Telephone Company for an accounting on stocks received by the Bell company as rentals and royalties for telephone licenses. The present case was placed with Mr. Everett W. Burdett, as a special master of the court, on Feb. 1, 1904, and the award, just confirmed, was made in 1909. Under the award the Western Union Telegraph Company will receive $2,579,914 in cash and 20,087 shares of stock which had been received by the Bell company as rentals and royalties for licenses to use telephones.

The litigation arose under a contract made in 1879 under which the Western Union Telegraph Company retired from the telephone field. At that time there was a struggle for supremacy in the telephone field between the Western Union and the National Telephone Company, now the American Bell Telephone & Telegraph Company, and a compromise was finally arranged whereby the Western Union Company agreed to go out of the telephone business and to turn over all of its telephone patents to the Bell company, the latter agreeing not to enter the telegraph field and to pay the Western Union 20 per cent of all rentals and royalties received from licenses or leases for telephones in the United States for a period of seventeen years. After this contract was made the Bell company gave exclusive licenses to companies in various parts of the United States for a certain percentage, generally 35 per cent, of their stock. For four years after making the contract the Western Union received an annual income from telephone royalties of between $400,000 and $500,000, but in 1883, when these transactions came to its attention, the telegraph company entered a protest and the litigation just ended was begun. The case was first given to a referee, who ruled that the Western Union was not entitled to recover, which decision was confirmed by the federal court. The case was then taken to the Court of Appeals, which gave the decision entitling the Western Union to 20 per cent interest in the shares of the Bell sub-companies, with accrued dividends during the seventeen years of the life of the contract. This was in 1904, when Mr. Burdett was appointed receiver, and the recent confirmation of his award ends the long-drawn-out litigation.

Sectional Trolley Wire Patent Declared Void.

In our issue of Nov. 17, 1910, an abstract was given of an opinion rendered by Judge Bradford, of the United States Circuit Court of the Eastern District of Pennsylvania, sustaining broadly a patent granted Sept. 10, 1895, to William M. Schlesinger covering the use of a sectional trolley wire in connection with safety cut-outs. Upon appeal the case was taken before the United States Circuit Court of Appeals of the Third District, and last week an opinion was handed down reversing the decision of the lower court.

The opinion of the court, which was rendered by Judge Buffington, after discussing the various points at issue, held that it is clear that in 1885, when Schlesinger first applied for his patent, he had not made and did not disclose the device covered by the contested claim which appears in the patent as issued. The original claims were broadly for sectional working conductors with safety catches for each section irrespective of whether single or multiple feeders were used, while the subject-matter of the claim in suit comprises separate feeding conductors, thus broadening the device to cover supply of electricity—a material change of front.

The situation presented is that of a patent application made in the early stages of the electrical art covering an electric car service, which application was promptly and properly rejected. The righteousness of this rejection remained unchallenged for some seven years, and, indeed, appears now unchallengeable if the disclosures then made constitute the sole ground for the patent. During this interim there was a rapid and general advance in the railway art, and when, therefore, the patentee, seven years after his original application and enlightened by such intervening years of progress, seeks, not to prosecute his original application, but to amend the same, and on the basis of such amendment to make claims of a different character from those originally made, it becomes the duty of the court to scrutinize zealously and jealously such belated application.

In conclusion the court held that Schlesinger's amended application and later claim constituted a distinct departure from his prior application, and that the claim in question was therefore wrongfully issued and void. The decree of the court below was ordered revised and the bill dismissed.

Boston $100,000 Electric Vehicle Campaign.

The Edison Electric Illuminating Company of Boston will start immediately a $100,000 campaign of education and for the exploitation of the electric vehicle in the 550 square miles of territory covered by its lines. The company has recently purchased thirty-four electric pleasure and commercial vehicles and will replace about 120 more of its horse wagons and thirty-nine gasoline cars with electrics. Orders for the vehicles will be distributed among different manufacturers who are factors in the Boston territory. The Edison company is also equipping and will operate a public garage under the auspices of the Electric Vehicle Association of America, which will give a low rate for complete service to encourage the industry.

The campaign will be inaugurated at a dinner and conference in Boston on March 3 given by the Edison Electric Illuminating Company. Seventy-five electric vehicle companies, motor manufacturers and allied industries have been invited and also all local vehicle representatives. The Boston Automobile Show opens the next day, in which every square foot of exhibition space has been sold, though the total space is 50 per cent more than at the recent New York Show, with an overflow that fills Horticultural Hall completely.

Twenty-fifth Anniversary Dinner of Boston Edison Company.

The twenty-fifth anniversary of the inauguration of service in the first generating plant of the Edison Electric Illuminating Company of Boston was observed on the evening of Feb. 20 at the Algonquin Club, Commonwealth Avenue, by the officers and some of the employees of the company. President Charles L. Edgar occupied the chair, and Vice-president Walter C. Baylies and nearly all of the members of the board of directors occupied seats at the head table. About 125 persons were present. At a special table with the committee in charge of the celebration sat Mr. C. S. Hadaway, the oldest employee of the company in point of continuous service. President Edgar acted as toastmaster, and Mr. Everett W. Burdett and Mr. W. C. Baylies were the principal speakers. The company began the supply of electricity on Feb. 20, 1886, to the Bijou Theater on the occasion of a production of "Iolanthe." Today the company serves an area of about 625 sq. miles and a population of considerably over 1,000,000 persons. About 1200 persons are employed by the company, and its annual station output is about 100,000,000 kw-hours.

Meeting of Electric Vehicle Association of America.

The regular monthly meeting of the Electric Vehicle Association of America was held in the Engineering Societies Building, New York, Feb. 27. In the absence of President Blood, Vice-president Arthur Williams occupied the chair. The topic for the evening was an illustrated paper by Mr. Alexander Churchward, of the General Electric Company, and chairman of the standardization committee of the association, on "The Standardization of the Electric Vehicle—Part I—Voltage." After reviewing briefly the desirabilities of standardization in the number of cells to be used in electric vehicles the author pointed out that this was easily obtainable with the commercial vehicles, but not so in the case of pleasure vehicles, where a great variation exists. The crux of the paper was a plea for the adoption of some standard or standards which would help the owner, builder and central station. At present vehicles in operation possess anywhere from 10 cells to 44 cells of acid battery and from 40 cells to 62 cells of alkaline battery, so that the maximum charging voltages required range from 26 volts to 112 volts. The author proposed a standard for lead batteries of 30 cells, 40 cells and 42 cells and 40 cells, 60 cells and 62 cells for the nickel-iron battery. This would mean the adoption of two charging voltages with a small amount of regulating resistance.

By means of curves, which will not be a part of the paper, the author then showed the influence of voltage on the efficiency of the motor and controller equipment. At overloads the efficiency falls off considerably in the lower voltages, due principally to brush losses. To overcome this it was suggested that a composite graphite-copper brush be employed, but this necessitates a special motor because the commutation characteristics of the standard motor using graphite brushes are not correct for a composite brush. The author felt that if the voltage were increased the number of cells in all the various makes of vehicles of a given capacity will be the same and the charging current will be approximately the same for the same size vehicle of different makes also. When one or more standard voltages are adopted then charging plugs, cables and resistances can be made to take care of all makes of vehicles and conditions will be better for the central station than they are at present.

Discussion.

Mr. J. W. Lieb, Jr., of the New York Edison Company, in opening the discussion by invitation told of the great advantages of standardization in other industries and emphasized the benefits to be derived from standardization in the electric vehicle industry while it was still in its infancy. Afterward, he said, when the capital invested is very great, standardization would entail great sacrifices which manufacturers might not be so willing to make.

Mr. Bruce Ford, of the Electric Storage Battery Company, suggested that where the acid and alkaline batteries are close, as in the proposed standard, the acid cell figures be shifted to coincide with those of the alkaline cell.

Mr. J. D. Forrer, of the Westinghouse company, said that simplicity and cheapness are essential attributes to standardization. If the voltages be maintained within the range of the three-wire system there will be much latitude available in charging, with resulting economy.

Mr. Lloyd, of the General Vehicle Company, commented on the absence of standard central-station voltages and also standard rates. Mr. Lloyd, of the Philadelphia Electric Company, said that central-station voltages ranged between 110 and 115, and Mr. Lieb, of the New York Edison Company, said 108 to 118 would be about the limits in direct-current systems. Mr. Lieb also explained the origin of this difference. When incandescent lamp filaments were made of bamboo threads the lamp manufacturer tried as best he could to turn out 110-volt lamps. Most of them were lamps of this voltage, but there were also a number of lamps ranging from 104 to 118 or over. These were separated and one city would receive 110-volt lamps, another 108-volt lamps, another 118-volt lamps and so on, so that the voltage of the system in any city at that time depended on the voltage of the incandescent lamp obtainable. Once established the voltage has persisted.

Mr. Kennedy, of the Studebaker company, felt that the industry was not ready for standardization just yet and that until the manufacturers sold more vehicles the central stations should put up with the variations in the number of cells.

Mr. Ward, of the Ward Motor Vehicle Company, said his company started out in the business with the assumption that the standard voltage was 110 and, therefore, equipped its vehicles with 42 cells and 80-volt motors with satisfactory results.

Much of the discussion drifted to the question of rates, and this was evidently to the liking of the vehicle manufacturers, most of whom had something to say on the subject. It was pointed out by the central-station men present that rates were not germane to the subject of the evening and new rates could not be made off-hand, nor would public service commissions pass them without warrant. Mr. Williams said that in a number of the large cities the rate question, especially as it applied to electric vehicles, was being looked into and receiving careful attention and that in due time the results would be announced.

Mr. F. Smith, of the United Electric Light & Power Company, then outlined the tentative program for the next months. At the March meeting a paper on "Tires" will be presented and possibly some experiences by owners and others of the behavior of electric vehicles in snowstorms. At the April meeting Mr. Kennedy, of the Studebaker company, will present a paper on operating costs in large garages. The May meeting will be addressed by Mr. W. W. Freeman, of the Brooklyn Edison company, and the subject will be co-operative advertising for boosting the electric vehicle. There is also the possibility of a joint meeting with the N. E. L. A., in convention at that time in New York. Messrs. Myer and Lloyd, of the Philadelphia Electric Company, will present a paper in the fall on the central station and the electric vehicle industry.

Meeting of the Philadelphia Electric Company Section, N. E. L. A.

The regular monthly meeting of the Philadelphia Electric Company Section, N. E. L. A., was held Feb. 20, 1911. Reports of the committees were submitted, those of the membership and the awarding of prizes committees being of chief interest. The membership committee reported that the total membership to date is 420.

The committee on the awarding of prizes reported that nineteen suggestions were received and three awards made as follows: First prize to Mr. E. S. Wilson, second prize to Mr. W. M. Barnes, and third prize to Mr. George G. Finley.

The winning suggestion was to the effect that a competent representative visit each new consumer after the first monthly bill had been delivered in order to be assured that the service is satisfactory, and if possible to interest the consumer in electrical devices, such as electric irons, chafing dishes, coffee percolators, etc., etc.; also that a central incandescent-lamp station be located at which all renewed lamps should be graded and redistributed. The suggestion winning the second prize was that in each issue of *Current News* a part should be set aside for the latest electrical developments, attaching thereto a short description which would place before every employee of the company the most modern electrical devices as developed. The third suggestion covered data for solicitors, suggesting that a loose-leaf book be developed in which could be placed illustrations of modern devices, such as shades, signs, photographs of interior and exterior lighting, etc.

The secretary announced that Dr. Spitzka would deliver a lecture on "The Effects of Electricity on the Human Body" on March 20.

The paper of the evening, "The Work Involved in Handling Consumers' Accounts by the Tabulating System," by Mr. H. R. Kern, was ably presented, and covered that branch of company's accounting pertaining to the consumer very thoroughly.

Mr. Cremer, representing the Hollerith Company, made a brief address, in which he outlined the history of the Hollerith tabulating machine, it being brought out that this machine was developed in order to record and subdivide properly the census report. The machine made its appearance after the census of 1880 and was first used in the census of 1890. By its use the work can be done ten times as fast as and at one-third the cost of a system employing regular clerical methods. Both Mr. Kern's and Mr. Cremer's talks provoked considerable discussion and many points which heretofore have not been understood were explained. Unfortunately, the weather conditions were anything but ideal, which kept the attendance down to fifty-five members and guests.

On March 1, at the commercial department branch meeting, a lecture by Mr. Nelson B. Hazeltine, of the Holophane Company, was given, the subject being "Reflecting and Diffusing Mediums for Artificial Illumination in the Home," and on March 2 the accounting department will have its meeting, at which papers will be presented and also a short sketch entitled "His Model Wife."

Relation of Meter Efficiency to Revenue.

At the February meeting of the Brooklyn Company Section of the National Electric Light Association Mr. William Eichert read a paper on the relation of meter efficiency to revenue in which he emphasized the necessity of a systematic method of maintaining watt-hour meters and pointed out the importance of the commercial side of the subject. The author said that it is an easy matter to maintain accuracy regardless of cost, but to do so at a minimum cost is the duty of the progressive meter engineer. As an illustration of how a company's income can be affected through inaccurate meters, the author submitted two tables, one containing an estimate of the average kw-hour consumption per annum of various classes of installations and the other containing an estimate of the kw-hours lost each year on residence installations through slow meters. The multiples given below the table are for determining the losses for other classes of installations.

A careful study of these figures shows clearly that if meters do not have proper attention the earnings of a company may be considerably decreased.

In selecting a meter the author stated that it is unwise to accept all the manufacturer's claims as to the accuracy of the instrument. The lighting companies in the State of New York are governed by the Public Service Commission as to the rules and tests to which new meters should be subjected before they become accepted types. Nevertheless when meters are delivered and before they are set they should be subjected to tests. Each meter should be adjusted on 10 per cent and 100 per cent load and a thorough inspection made to discover mechanical defects. Alternating-current meters should be tested on a power-factor of about 60 per cent to insure accurate registration on inductive loads.

On the selection of meters for various installations the author had much of importance to say. This question is of moment from the financial standpoint, as it is obvious that the demand factors vary, and if meters are installed of the same capacity as the installation without regard to the demand factor considerable revenue is lost in cases where only a small percentage of the installation is used at any one time. For example, a sign having 100 50-watt lamps on a three-wire circuit would require a 25-amp, 230-volt, three-wire meter, as the demand factor in this case would be 100 per cent of the meter's capacity, while in the case of a residence having 100 50-watt lamps the demand factor would be only about 20 per cent and a meter of much smaller capacity would suffice. This distinction is made for the reason that meters have a tendency to register slow on light loads, and it is obvious that unless some consideration is given to the demand factor the majority of meters would be registering on light loads at a loss to the supply company. The author gives the schedule printed on the next page for determining the proper size of meters to be employed.

When metering direct-current motor circuits the question of inrushes must also be considered, as the tendency of inrushes is to weaken the retarding magnets of the meter and cause over-

TABLE I.—ESTIMATED ENERGY CONSUMED BY VARIOUS INSTALLATIONS YEARLY.

Total Kilowatts Connected.	Residence Lighting.	Business Houses.	Saloons, Confectionery.	Signs and Outline.	Motors 8 Hours per Day.	Motors 24 Hours per Day.
.6	150	600	900	1200	1,500	5,000
1.2	300	1,200	1,800	2,400	3,000	10,000
1.8	450	1,800	2,700	3,600	4,500	1,5000
3.0	750	3,000	4,500	6,000	7,500	25,000
6.0	1,500	6,000	9,000	12,000	15,000	50,000
9.0	2,250	9,000	13,500	18,000	22,500	75,000
12.0	3,000	12,000	18,000	24,000	30,000	100,000
18.0	4,500	18,000	27,500	36,000	45,000	150,000
36.0	9,000	36,000	55,000	72,000	90,000	300,000
72.0	18,000	72,000	110,000	144,000	180,000	600,000

TABLE II.—KW-HOUR LOSS PER ANNUM DUE TO SLOW METERS.

Meter Efficiency	TOTAL CONNECTED RESIDENCE INSTALLATION IN KILOWATTS									
	.6	1.2	1.8	3.0	6.0	9.0	12	18	36	72
99%	1.5	3.0	4.5	7.5	15	22	30	45	90	180
98%	3.0	6.0	9.0	15.0	30	45	60	90	180	360
97%	4.5	9.0	13.5	22.5	45	67	90	135	270	540
96%	6.0	12.0	18.0	30.0	60	90	120	180	360	720
95%	7.5	15.0	22.5	37.5	75	112	150	225	450	900
94%	9.0	18.0	27.0	45.0	90	135	180	270	540	1080
93%	10.5	21.0	31.5	52.5	105	157	210	315	630	1260
92%	12.0	24.0	36.0	60.0	120	180	240	360	720	1440
91%	13.5	27.0	40.5	67.5	135	202	270	405	810	1620
90%	15.0	30.0	45.0	75.0	150	225	300	450	900	1800

For business houses multiply by 4; for saloons and confectionery multiply by 6; for signs and outline lighting multiply by 8; for motors (8 hours per day) multiply by 10; (24 hours per day) multiply by 30.

registration. To overcome this difficulty it is the practice to install a meter having a capacity as nearly equal to that of the inrush as possible without losing sight of the demand factor.

The author then dwelt on the question of meter locations, installation tests and inspections. The schedule of periodic tests adopted by the Brooklyn Edison Company is as follows: One test every two years, single-phase induction meters of all sizes; one test per annum, direct-current meters up to and including 25-amp capacity; two tests per annum, direct-current meters from 50-amp to 100-amp capacity, and polyphase meters; four tests per annum, direct-current meters from 100 amp and over; six to twelve tests per annum, meters for large consumers

TABLE III.—SCHEDULE FOR DETERMINING CAPACITY OF METERS TO INSTALL LAMPS.

Class of Installation.	Per Cent of Total Load.
Residences and ap..rtments	25
Churches, theatres, clubs, hallways, entrances, general stores, and offices	60
Saloons, restaurants, moving-picture machines, general arc lighting, and charging outlets	75
Signs, outline, and window lighting	100

TABLE IV.—MOTORS—MINIMUM CAPACITY IN AMPERES PER HORSE-POWER.

Current.	115-V.	230-V.	500-V.	2400-V.	6600-V
Direct	6	3	1.4	..	..
Alternating, single-phase	8	4	..	..	..
Alternating, two-phase	4	2	..	.2	..
Alternating, three-phase	5	2.5	..	.25	.08

NOTE.—No meter shall be installed of less amperes per horse-power than shown in this table.

operating from eight to twenty-four hours a day. In addition the company has a number of customers which it supplies with energy from its high-tension feeders. These meters, being operated from shunt and series transformers, are tested from two to six times per annum. In testing meters on consumers' premises the company is bound by the rules and regulations promulgated by the Public Service Commission.

TABLE V.—METER EFFICIENCY WITH RESPECTIVE JEWELS.

Total Tests.	Type of Bearing.	Efficiency at 10% of Load.	Efficiency at 100% of Load.
	T. R. W. Meters,	Direct-Current	
1085	Sapphire	89.4	97.5
1030	Diamond	96.5	98.5
	Type C Meters.	Direct Current.	
1344	Sapphire	96.8	99.2
499	Diamond	98.2	99.7
	Type I Meters.	Alternating Current.	
848	Sapphire	97.6	99.5
	Type D Meters	Alternating Current.	
507	Sapphire	97.2	98.8
306	Diamond	98.8	100.2

Most of the meters used by the Brooklyn Edison Company operate on jewel and pivot bearings. The manufacturer of these meters supplies sapphire jewels in meters up to 100-amp capacity and cupped diamond jewels in meters of larger capacity. It has been found in practice that a sapphire bearing will not stand very much wear and tear owing to the softness of the stone, and when a jewel becomes worn or roughened it increases friction to such an extent that the meter becomes very inaccurate. In cases where vibration is very heavy a hole is sometimes worn through the stone and the meter stops entirely. In order to overcome this difficulty the company has found it necessary to dispense with the use of sapphires almost entirely and use diamond jewels. The tabulation printed above shows the increase in efficiency when diamond jewels are used.

Massachusetts Legislative News.

The Senate has refused to order a third reading of House Bill 1466, which provides that no charge shall be made by gas companies for the use of meters. The committee on public lighting has sent in an adverse report on House Bill 744, providing for legislation to regulate the price of gas in the city of Woburn. The committee recognizes that bills of this character, which are frequently presented for the consideration of the General Court, strike a direct blow against the adjudication of gas and electric rates by the State commission having jurisdiction over these public-utility corporations. The Legislature has thus far consistently refused to undertake such regulation of rates and has rejected specific bills which tend to turn back the rate-fixing procedure to the General Court, preferring to leave such problems to the expert tribunals most competent to deal with them. A resolve granting the Massachusetts Institute of Technology $100,000 annually for the next ten years has been reported by the committee on education. The committee on public lighting has reported a bill authorizing the town of Danvers to supply electricity in the towns of North Reading and Middleton.

A hearing was given by the committees on railroads and metropolitan affairs on Feb. 24 upon the petition of the Boston & Eastern Electric Railroad Company (M. H. Woodbury) for the passage of a bill insuring the issuance of a certificate of exigency to the company by the Railroad Commission. C. S. Baxter, counsel for the company, reviewed the history of its attempts to secure authority to spend $12,000,000 in building a high-speed electric interurban railroad between Boston and the North Shore cities and towns, including Lynn and Salem. He contended that the merits of the project have practically been admitted by the commission and severely criticised the majority of the board for its refusal to issue a certificate which would enable the company to take immediate steps toward construction. During the hearing Representative Wolcott brought out the point that the New York, New Haven & Hartford Railroad Company's plan to electrify the Boston, Revere Beach & Lynn Railroad and build a tunnel under Boston Harbor for the purpose of providing rapid transit from Essex County and furnishing quicker service between the northern and southern suburban districts of Boston might seriously interfere with the Boston & Eastern development. It is generally admitted that this substantial adoption of the Boston & Eastern Company's plans by the existing systems is the chief obstacle in the way of the building of a new electric road. There appears to be little doubt that an electrified rapid transit service between the populous centers of the North Shore and the heart of Boston will be realized in the comparatively near future.

New York Commission News.

The Public Service Commission, Second District, served orders upon the Catskill Illuminating & Power Company and the Ithaca Gas Light Company to appear before the commission on Monday, Feb. 27, and show cause why suit should not be begun against them to recover penalties for failure to manufacture and distribute gas in accordance with the prescribed standards. The routine tests of the gas of these companies having shown deficiencies, an inspector was assigned to make a careful and thorough inspection of the quality. In each instance the gas was found not to meet the requirements as to candle-power. Each company supplies coal gas, for which the illuminating power is 16 cp.

The Buffalo General Electric Company has been authorized to issue its thirty-year 5 per cent gold bonds to the amount of $420,000. The bonds are to be sold at not less than 95 and the proceeds used for the acquisition of certain property at the northeast corner of Washington and Huron streets in the city of Buffalo and for the construction thereon of a building for the general uses and purposes of the company.

A complaint has been received from the Keeseville Telephone Company stating that the Ausable Home Telephone Company has entered its field in the village of Keeseville and installed telephones upon the free-trial-service plan until at present the Ausable company has seventy-five substations in that village. The Keeseville company also complains that the Ausable company is discriminating in the question of toll rates as between subscribers. The complaint has been served upon the Ausable company and an answer required within ten days.

A petition has been received from residents of the village of Newark, Wayne County, directed against the Wayne Telephone company as to the rates charged by that company under a schedule which went into effect Feb. 1, 1911, and the discontinuance of the sale of coupon books. The petition alleges that the new rates are unjust, unreasonable and unjustly discriminatory and are higher than the rates charged by the same company for like services in other villages in Wayne County. The complaint has been served on the company and an answer required within ten days.

A complaint has been received from the Newburgh News Printing & Publishing Company and other residents of Newburgh directed against the rates charged for gas and electricity by the Newburgh Light, Heat & Power Company. The complaint alleges that the rates charged are unwarranted and excessive and asks for an investigation of the works, plant, system and methods of the company, with a view to determining the price to be charged for gas and electricity in the City of Newburgh.

Wisconsin Commission News.

During the past two weeks the commission has listened to the arguments in the matter of the application of the Kenosha Electric Railway Company for a certificate of convenience and necessity. This petition was entered into jointly by the city and the electric railway company and has been vigorously opposed by the Kenosha Gas & Electric Company. The case grew out of the franchise granted by the City of Kenosha to the electric railway company under the terms of which the company was to furnish the municipal lighting and to engage in a general lighting and power business in opposition to the Kenosha Gas & Electric Company, from which the city was unable to obtain a satisfactory contract for street lighting. This action was taken upon the expiration of the street-lighting contract with the gas company. The railway company began installing adequate machinery and commenced doing business immediately upon the granting of the franchise. Thereupon the gas company surrendered its franchise and received an indeterminate permit from the State. The company then secured an injunction restraining the railway company from extending its business, upon the claim that the indeterminate permit barred the railway company from doing a competing business, and the latter was defeated in its appeal, for the Supreme Court upheld the indeterminate-permit law. The application for a certificate of convenience and necessity was then filed with the commission.

The testimony shows that the Kenosha Gas & Electric Company has failed to give satisfactory service, either as to quality or price; that the equipment is not sufficient to furnish the service necessary or that would be necessary were the gas company to do the entire electric utility business; that the attitude of the management has antagonized the citizens and that no improvement in this respect has been evident notwithstanding the many appeals of both Council and citizens; that no effort has been made or is being made either to improve or to extend the company's business.

From statistics reported to the Railroad Commission it was shown that the gas and electric company has 2.6 consumers per 100 inhabitants, whereas the average of thirteen cities, ranging in population from about 7000 below to 8000 above that of Kenosha, shows an average of approximately six consumers per 100 of population. From the tests made by the inspectors of the commission it was evident that the standards of service have not been maintained in a manner at all satisfactory. The testimony showed, furthermore, that the total cost per average kw-hour generated by the gas company was 6.69 cents. With the new equipment installed and a light and power franchise it was estimated that the railway company could generate energy at an average cost of 3.6 cents per kw-hour.

The case has aroused considerable interest in the State because of the many features involved and because of the fact that it is the first time, under commission control, where a second company has endeavored to enter a field in competition with an existing company. This case is the natural result of a public demand for better conditions, occasioned by a company's general disregard of its obligations as a public utility. The Kenosha Gas & Electric Company is controlled by the Milwaukee Light, Heat & Traction Company.

Upon application to the commission the Mount Morris Farmers' Telephone Company has been empowered to effect a material increase in its rates and tolls. On the basis of the increased valuation occasioned by a considerable improvement in the service, and a rate of depreciation of 6½ per cent, the company will be earning 7 per cent upon the investment under the new rates, which is the rate generally allowed by the commission.

The commission has canceled its certificate, dated Aug. 31, 1910, authorizing the Clifton Light & Power Company to issue $25,000 par value of bonds and has approved an issue of $200,000 par value of 6 per cent bonds. The bonds are to be issued and sold for the purpose of supplying funds for the purchase of additional pole lines, right-of-way, real estate upon which to construct another dam in the town of Clifton, Pierce County, Wis., and other structures necessary to the carrying on of a general hydroelectric business.

The commission has authorized the Horicon Light & Power Company to issue $10,000 par value of 6 per cent bonds and 100 shares of common stock of the par value of $100 each. The entire issue of stock and bonds, to an amount not to exceed $5,000, is to be issued to the Beaver Dam Light & Power Company in exchange for a transmission line constructed by it between Beaver Dam and Horicon and a substation and distributing system at Horicon. The balance of the bonds are to be sold for money only and at not less than 80 per cent of their par value.

New Jersey Commission News.

A question as to the right of the Board of Public Utility Commissioners of New Jersey to assist in maintaining a monopoly by withholding its approval of a franchise from one gas company seeking to compete with another already established was raised at a hearing upon the application of the Atlantic Highlands Gas Company for approval of an ordinance passed by Shrewsbury Township granting it a franchise to operate within that municipality. The board's approval was opposed by the Consolidated Gas Company of New Jersey, which is already in the field. For the latter company it is claimed that before May 1 the Consolidated company will have piped all the territory within which the Atlantic company proposes to operate. It is also contended there would be no benefit to the community from a duplication of the franchise.

The attorney for the Atlantic Highlands Company raised a question as to the power of the board to protect the monopoly from the competing company. He pointed out that the territory which the new company proposes to serve is now without gas, and claimed that although the Consolidated company had had ample opportunity to provide for such service it had made no effort to do so until the Atlantic Highlands Company attempted to enter the field and supply the public demand. The board reserved decision.

The Board of Public Utility Commissioners has approved the application of the Atlantic City Electric Company for the issuance, sale and delivery of $10,000 first and refunding mortgage 5 per cent sinking gold bonds at the par value thereof.

Joseph Wetzler.

Cable advices from London announce the death in that city of Mr. Joseph Wetzler on Feb. 22 from heart failure. As no previous news had reached friends in this country as to his illness, the intelligence has been a most painful shock. Mr. Wetzler was born at Hoboken, N. J., Dec. 6, 1863, his father, a German, being one of the founders of the leather industry in New York City. He showed early a strong inclination for mechanical study and at the early age of nineteen graduated from the Stevens Institute of Technology in the class of 1882. Entering the Weston factory of the old United States Electric Light Company at Newark, he spent a year there and then began to indulge his taste for technical writing. As a member of the staff of the *Scientific American* he made and described a series of interesting studies on the magnetic conditions of the iron and steel buildings on Manhattan Island and on the polarity of the new Brooklyn Bridge. This work attracted the attention of the management of the *Electrical World*, which had started in 1883, and he joined its staff as an associate editor, 1884-5, part of his first work being the compilation of a proposed American electrical phrase book, based on his translations from the French and German. He is entitled to no small share of the credit of building up the *Electrical World* and later, in 1890, of establishing the weekly *Electrical Engineer*. He retired from active journalism when the two properties were merged in 1899.

JOSEPH WETZLER.

Mr. Wetzler was a man of broad outlook and sympathies and intensely interested in educational work. He helped to found the American Institute of Electrical Engineers as a charter member, in 1884, and served both as manager and as vice-president. He represented the Institute as a delegate to the Paris Electrical Congress of 1889. He was also prominent in the affairs of the New York Electrical Society and was its president 1892-3-4. He was also a member of the Institution of Electrical Engineers of England, the Elektrotechnischer Verein of Vienna, the American Electrochemical Society and the American Association for the Advancement of Science. He was a member of the Masonic Order and one of the early and active members of the Reform Club of New York. He was, in addition, active and influential in the upbuilding of the Hebrew Technical Institute of New York.

In the spring of 1898 Mr. Wetzler founded the Electrical Engineer Institute of Correspondence Instruction, which has educated creditably many thousands of students in electricity by the written method. Owing to the rapid increase in the number of students in Great Britain and the colonies he saw it to be necessary to establish offices in London. Going over for that purpose, he had remained there ever since, administering the affairs of the Institute and gratifying in England and on the Continent his passion for music and the sciences. His wife (Miss Pauline Gerson) and he had a host of friends all over Europe and were constantly in France, Germany and Austria. He had many flattering invitations to return to America and was named once or twice for educational positions of influence, but could not be induced to return to this country, although the damp English climate was harsh to a constitution never very robust.

Mr. Wetzler was a voluminous writer. He assisted Dr. E. J. Houston in the issuance of the well-known "Electrical Dictionary"; in 1887 was joint editor of the first American book on the electric motor and electric railway; was an editor of the electrical section of Appleton's "Cyclopædia of Applied Mechanics," and contributed to the electrical series in *Scribner's Magazine*, afterward put into book form. He did also a considerable amount of translating, revising, compiling and annotating for various handbooks and other kindred publications, work for which a command of foreign languages and an extraordinarily retentive memory made his services peculiarly valuable. In these ways, and through his wide friendly acquaintance with all the great inventors and engineers, he was able to make a deep impress on the electrical journalism and development of the day; and his untimely death will cause him to be deeply lamented and missed on both sides of the Atlantic.

CURRENT NEWS AND NOTES.

Meter Reading and Photography.—Courtesy and ingenuity were combined by a North Side customer of the Commonwealth Edison Company, Chicago, who sent a photograph of the watt-hour meter and maximum-demand indicator on his premises at a time when the meter reader was unable to obtain access owing to the customer's absence during the greater part of the day. This voluntary action enabled the company to send a correct bill.

Central-Station Lectures.—Professor Ernst J. Berg, of the University of Illinois, is delivering a second course of lectures on electricity and applied electricity before the employees of the Commonwealth Edison Company of Chicago. Of four lectures two remain to be delivered, the dates being March 11 and April 22 and the place Recital Hall, Auditorium Building. The respective subjects are *Direct-Current Generators* and *Shunt and Series Motors.*

Michigan Electric Association's Proceedings.—The proceedings of the seventh annual convention of the Michigan Electric Association, held in Port Huron, Mich, Aug. 16-18, 1910, have been published in a cloth-bound book of 101 pages, embellished with a portrait of Mr. A. C. Marshall, of Port Huron, the 1909-10 president of the association. Mr. Herbert Silvester, of the Peninsular Electric Light Company, of Detroit, is secretary of the association.

Novel Use of the X-Ray.—A would-be immigrant to the United States from China was recently subjected to an X-ray test at Boston to determine his age. Photographs were taken of the wrist and knee bones by the radiographic method at the suggestion of the alien's counsel, who sought thereby to prove his client to be seventeen and not twenty-five years of age, as claimed by the immigration officials. It is reported that the Chinaman successfully met the demonstration.

A Large N. E. L. A. Question Box.—Under the energetic editorship of Mr. M. S. Seelman, Jr., the Question Box of the *Bulletin* of the National Electric Light Association has developed in a surprising manner. The previous editors have done excellent work in building up the department, and now in the February issue it has been necessary to devote no fewer than ninety-four pages to the box. The range of questions and answers indicates the immense variety of the technical and commercial questions now arising incessantly in the field, while it is interesting to note that many of the questions are answered by the foremost men in the industry. This is leadership and co-operation of the highest kind.

Smoke Nuisance in Milwaukee.—Milwaukee has aligned itself with the considerable number of cities fighting the smoke nuisance. A committee of citizens has been formed, and the adoption of a more drastic ordinance and the bringing of suits against offenders are under discussion.

Central-Station Business in Rural Communities.—The North Shore Electric Company, which recently extended its service into a wide country area north and northwest of Chicago, is securing considerable business from agriculturists and "gentlemen farmers" in the vicinity of Barrington, Libertyville and Fox Lake, Ill.

Winnipeg River Water-Powers.—According to a recent estimate water-power aggregating 437,000 hp is available along the course of the Winnipeg River between Kenora and Lake Winnipeg, a distance of 140 miles. Of this total, authorization has been given for the development of 125,000 hp, the remainder being still under the control of the government.

Denver Electric Club.—An interesting talk on electricity for advertising purposes was given by Mr. G. E. Williamson, illuminating engineer for the Denver Gas & Electric Company, at the weekly lunch of the Colorado Electric Club Feb. 23. This is the first of a number of technical talks which will be varied by talks on various matters of public interest such as have heretofore been usual at these meetings.

American Society of Mechanical Engineers.—The sixty-third meeting of the American Society of Mechanical Engineers will be held in Pittsburgh, Pa., from May 30 to June 2 inclusive. The society has not met since 1884 in Pittsburgh, where it has a membership of 160 out of a total of over 4000. An executive committee consisting of Messrs. E. M. Herr, chairman; George Mesta, J. M. Tate, Jr., Chester B. Albree, D. F. Crawford, Morris Knowles and Elmer K. Hiles, secretary, will have charge of the Pittsburgh meetings. It is expected that from 300 to 400 members and ladies will be in attendance. There will be professional sessions, when papers will be read and discussed, and inspection trips through the leading local industrial establishments, besides automobile trips through the parks, a visit to Carnegie Institute, Memorial Hall, etc.

Human Engineering.—The latest addition to the rapidly growing list of departments of "engineering" is "human engineering." The new branch has already an organ, *Human Engineering,* published monthly in Cleveland, Ohio. In this publication the branch is defined as "a new profession called into being by new conditions in the industrial world," and elsewhere is referred to as relating to the human side of industry and conservation of human energy. It differs from "manhood engineering," another recently established profession, in that the latter relates more particularly to ethical "uplift" work, while it seems to encroach somewhat on the territory of the new profession of "social engineering." Unlike the social engineer, manhood engineer, efficiency engineer, etc., the members of the new profession are somewhat handicapped with regard to titular designation, as the term "human engineer" has an element of ambiguity.

Electric Heating on a Large Scale.—A recent contributor to a Chicago daily newspaper looks forward to the day when it will be possible to keep the general temperature of the atmosphere at about 60 deg. Fahr. all the year around. In order to do this every fall of water must be "harnessed" to machinery capable of producing electricity. Should more power be needed, it will only be necessary to "harness" the tides. Then, according to this prophet: "With an unlimited supply of electricity at hand the problem of heating and cooling the atmosphere is only a mechanical one. * * * One hundred years from now no one will be permitted to secure heat or light by burning wood or coal. This will throw a great many out of work, but as everyone will secure heat and light for almost nothing, it will not mean hardship for anyone." It is rather interesting to observe the nonchalant way in which this seer dismisses the detail of heating or cooling the entire atmosphere as "only a mechanical problem."

Exportation of Electricity to Mexico.—A 40,000-volt electric transmission line is being constructed from the power plant of the Copper Queen smelter at Douglas, Ariz., to El Tigre, Mexico, sixty-five miles. In addition to supplying energy for operating the machinery of the mines and ore-reduction mills of El Tigre district industrial plants will be supplied at Fronteras, Ysabel and other places. It is stated that when the Copper Queen Mining & Smelting Company applied to the Mexican government for a concession to transmit electricity across the border several novel questions bearing on the international feature of the proposed business arose and were carefully considered. One of these was whether electricity came under any of the heads of commodities upon which a duty could be assessed. It was decided that the electric energy should be admitted free of duty. The transmission line is being strung on poles of Texas pine. The power plant of the Copper Queen company is being enlarged to provide the additional power for the new service.

New York N. E. L. A. Section Meeting.—The New York Edison Company's Section of the National Electric Light Association held its third regular monthly meeting on Monday evening, Feb. 20, 1911, at the Edison Auditorium, 44 West Twenty-seventh Street, New York City, about 300 members and their friends being present. Mr. Arthur Williams presided, and after a short business session Mr. C. E. Allen, of the Westinghouse Electric & Manufacturing Company, delivered an address upon distributing transformers illustrated with a number of good lantern slides. Mr. Henry Schroeder, of the General Electric Company, followed with an illustrated lecture on incandescent lamps, giving the history of the art of their manufacture from the beginning up to date. A successful vaudeville performance followed, after which the entertainment committee provided luncheon, together with cigars. This was the first social meeting of the section and the officers and committees felt much gratified at its success. The section has now a membership of 580, which promises to increase to 1000 before many months.

Rates Compared to Special Assessments.—In a long paper on "Public Relations of Telephone Companies," presented at the Chicago convention of the National Independent Telephone Association on Feb. 8, Mr. William Dunton Kerr, a public-service counselor, made this interesting comparison between special assessments and the rates of public-service utilities: "In many particulars charges for public services are nothing but special assessments levied upon the individuals directly benefited to defray the cost of the services. The purpose of special assessments is to distribute the burdens of particular public improvements among those benefited substantially in accordance with the benefits received by each. In like manner it is the function of the rate schedule of a utility to distribute the burdens of the service according to the benefits received by individual patrons. This is a rule of equality founded on the public character of the service. It is the first duty of government to do substantial equality to all citizens; it is no less the duty of a private company performing a governmental function. This duty can be performed only by a proper adjustment of rate schedules. The rate may properly be regarded as the agency for the distribution of service burdens according to the incidence of benefits."

Braking of Trains on Grades.—At a meeting of the Central Railway Club to be held at the Statler Hotel, Buffalo, on March 10 Mr. John P. Kelly will present a paper entitled "The Influence of Gravity on Trains Descending Grades and the Brake Power Necessary for Safe Control."

No N. E. L. A. New York Convention Exhibition.—In response to a circular letter, 97 per cent of the manufacturers' section of the National Electric Light Association voted to omit the customary exhibition at the annual convention of the National Electric Light Association to be held in New York City May 29 to June 2.

New York Section, I. E. S.—At the next meeting of the New York Section of the Illuminating Engineering Society, which will be held at Gimbel Brothers' store, at Sixth Avenue and Thirty-third street, on March 9, Messrs. Clarence L. Law and Albert Jackson Marshall will present a paper entitled "The Lighting of a Large Department Store," which will be devoted to the design and test of the lighting equipments in the Gimbel store.

New York Electrical Society Meeting.—The next meeting of the New York Electrical Society will be held in the Hispanic Society Building, 156th Street and Broadway, on Thursday evening, March 16. The speaker will be Mr. F. O. Blackwell, who will deliver an illustrated lecture on hydro-electric development in Mexico. The Hispanic Museum will be open for the inspection of the members of the electrical society.

Travel in the New York Subway.—The New York Public Service Commission has prepared a statement showing the yearly ticket sales at every station of the subway from the time of its opening on Oct. 27, 1904, to Dec. 31, 1910. The total number during this period was 1,212,771,225. The traffic increased from 116,209,313 passengers in 1905 to 270,321,490 in 1910. The total gross income at 5 cents per ticket has been more than $60,000,000.

Cost of Public Service Commission.—According to reports of the State Department on the cost of maintaining the Public Service Commission of the First District, New York, the cost of the commission to New York City has been nearly $1,100,000 a year, which is about ten times the cost of the commission for the Second District, which covers the remainder of the State. The former commission employs 614 persons, including many engineers and traffic experts. Each commissioner receives a salary of $15,000. Mr. John N. Carlisle has been selected to make a study of the expenses and accomplishments of the commission.

Electrically Driven Gas-Producer, Gas-Engine Ship.—A vessel built by Messrs. McLaren Brothers, Dumbarton, Scotland, to the joint order of that firm and Messrs. Mayor & Coulson, electrical engineers, Glasgow, has recently been launched and will be ready for official trials on the Firth of Clyde at an early date. She is 50 ft. in length between perpendiculars and 12 ft. in breadth, and she will be propelled by machinery consisting of a four-cylinder Crossley gas engine of 45 hp., using producer gas, with electrical transmission to the propeller. The vessel has been built primarily for demonstration purposes in order to show the efficiency of electrical propulsion, but she has been fitted with two saloons and she will have a certificate for fifty passengers.

Day Letter-Telegram Service.—As a result of its satisfactory experience with the "night letters," the Western Union Telegraph Company inaugurated on March 1 a system of "day letters." According to the official statement, the day letter-telegram, like the night letter-telegram, is a fifty-word telegram to be written in plain English, code words and code language not being accepted. It is to be transmitted as the facilities of the company will permit during business hours of the day, full-rate telegrams having priority of transmission. The rate charged for a day letter of fifty words or less is one and one-half times the fifty-word night-letter rate, and for each additional ten words or less one-fifth the initial charge. For example, the night-letter rate from New York to Chicago is 50 cents; the day-letter rate is 75 cents, with 15 cents for each additional ten words. The New York-Washington night-letter rate is 30 cents; the day-letter rate 45 cents, with 9 cents for each additional ten words over fifty. The New York-San Francisco day-letter rate is $1.50 for fifty words, with 30 cents for each additional ten words.

Engineering Education Commended at Boston.—Engineering education received high praise from representative publicists and business men at a recent legislative hearing at Boston in connection with the plea of President Richard C. Maclaurin, of the Massachusetts Institute of Technology, for a grant of $100,000 per year from the State for the next decade. Among the speakers were Frederic P. Fish, Esq., former president of the American Telephone & Telegraph Company; Mr. W. C. Fish, manager of the Lynn works of the General Electric Company; Commissioner of Public Works Louis K. Rourke, of Boston; President A. Lawrence Lowell, of Harvard University, and Mayor John F. Fitzgerald, of Boston. All the speakers expressed forcefully the far-reaching value of technical education to the State, emphasizing the increasing importance of the engineer in modern affairs. President Maclaurin pointed out the necessity of larger development on account of the successful and over-crowded condition of the Institute, showed how the increased cost of living has had to be faced in connection with the retention of able instructors, and said that a new location for the institution, with a new and effective plant, is an absolute necessity. He closed by showing that unless the State provides for higher technical education ti must decline in prosperity and influence, and drew a parallel between the conditions and policy of Germany and those of Massachusetts in fostering this class of training. The Institute authorities desire an increase in the annual appropriation by the State of from $25,000 to $100,000.

Meeting of Cleveland A. I. E. E. Section.—The Cleveland Section of the A. I. E. E. held its regular monthly meeting on Monday, Feb. 20, in the Engineering Building of the National Electric Lamp Association as guests of the latter and listened to three papers on subjects pertaining to electric illumination. The first was by Mr. H. T. Spalding on "Mazda Street Lighting." the second by Dr. P. W. Cobb on "The Physiology of Glare," and the third by Dr. Herbert E. Ives on "The Production of Artificial Daylight." Mr. Spalding presented numerous stereopticon views of various types of street-lighting fixtures and installations. Dr. Cobb discussed the effect of scattered light in the eye in diminishing sensibility. Referring indirectly to the tests of Mr. Arthur J. Sweet, which indicate that glare in artificial lighting is caused by light coming from sources located within a fairly definite angle of approximately 25 deg. with the direct line of vision, Dr. Cobb said that while 25 deg. or thereabouts may be the practical limit of glare effect, he was aware of no physiological basis for such a limit. Dr. Ives discussed and demonstrated the "additive" and "subtractive" methods of producing light of the color known as "average daylight." He produced light of this color, using the additive method, by adding light from a tungsten-filament lamp to that from a mercury-vapor lamp in the proportions of one to two, approximately. Using the subtractive method he cut off from the light of a tungsten-filament lamps by means of a selective screen just enough light of the longer wave-lengths so that the transmitted light had the color of average daylight.

HYDROELECTRIC ENERGY FROM A STATE CANAL.

Plant of Maumee Valley Electric Company Utilizing 62-Ft. Head Furnished by Miami & Erie Waterway.

FIFTY years ago the State of Ohio finished the old Miami & Erie Canal, a waterway connecting the Maumee and Miami Rivers and providing a navigable link between Lake Erie and the Ohio River for the large water-borne traffic of the period. From the broad reaches of the Maumee River at Toledo the canal ascends around the rapids above the city by a series of locks leading to a level section twenty-three miles in length fed from the storage reservoir impounded by the new Grand Rapids dam, built two years ago.

At a point eight miles southwest of the City of Toledo the twenty-three-mile level section of the canal approaches within 800 ft. of the river, here 62 ft. below it, making available an admirable water-power site by the construction of a lateral extension canal from the State waterway to the crest of the river bank.

Due to the competition offered by the railroads in the rapid handling of freight this old canal has fallen almost into disuse, barely one boat a year now traversing its grass-grown banks and rusty locks. The State has been unable to increase the canal traffic, even though the locks have been rebuilt and the canal put in the very best condition. In order, therefore, to place the canal property on a paying basis the State engineers consented to deliver water for power purposes, and this proposition was approved by the Ohio Legislature, the amount of water delivered being limited, however, so that the property will not be impaired or navigation destroyed.

To utilize this water-power the Maumee Valley Electric Company, originally organized some years ago, installed at that time one water-wheel unit and an auxiliary steam plant of approximately 800 hp, furnishing energy to operate an interurban belt line and other properties. Owing to various contingencies the power station was later shut down for a period of two or three years, until recently, when the company was reorganized and the power station rebuilt and enlarged.

The water-power generating capacity of this new station, operating continuously at full load, is transmitted eight miles at 13,200 volts into the City of Toledo, to augment the steam-power generating system of the Toledo Railways & Light Company, besides operating a local 300-kw railway rotary converter feeding directly into the 550-volt trolley of an interurban line which passes the power house. In addition to the water-wheel units the Maumee plant contains a 600-hp auxiliary steam engine which was installed at the time of the original station, several years ago, and can be connected to drive one of the water-wheel generators in case of emergency.

As above noted, the twenty-three-mile level section of the State canal is fed through one lock from the Maumee River above the new Grand Rapids dam, built two years ago. This dam impounds a reservoir in the old bed of the river, eighteen miles long and 1400 ft. wide, the storage capacity of which serves to maintain the canal system and developments below during low-water periods.

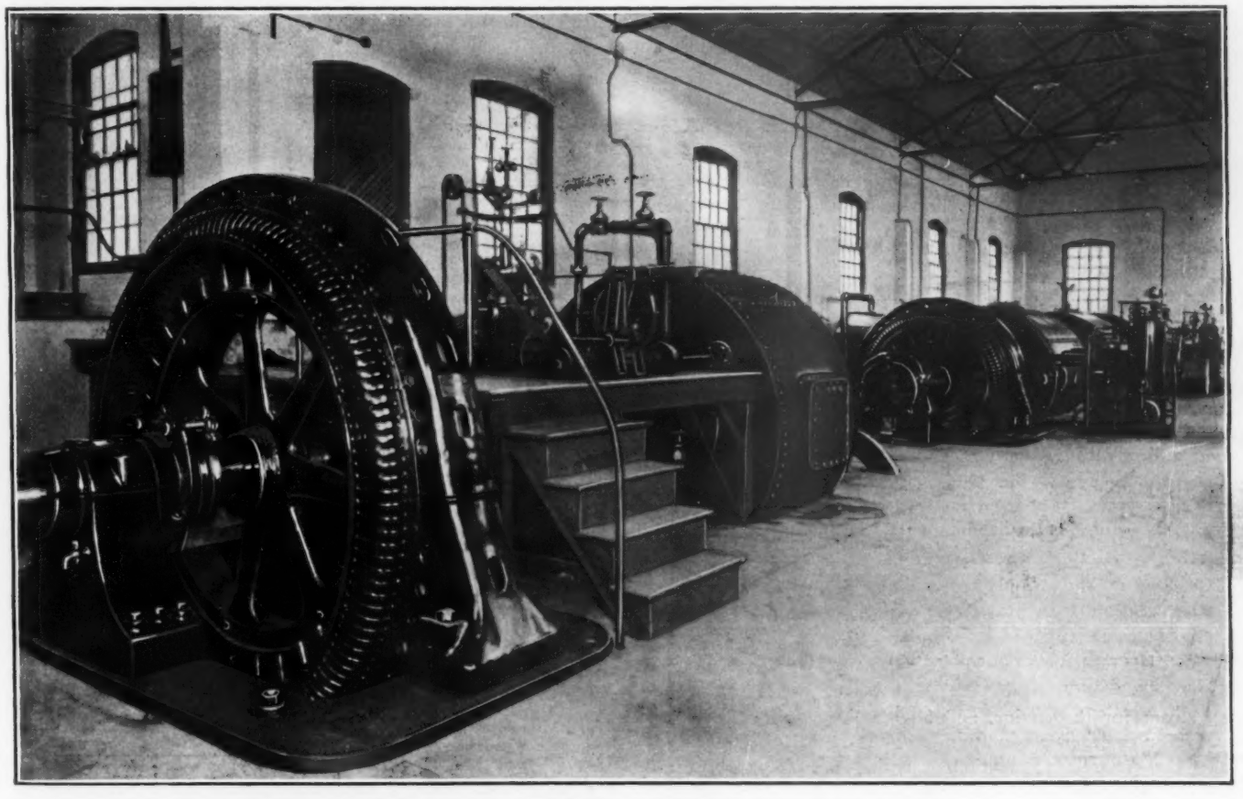


Fig. 1—Interior of Generator-Room, Showing Water-Wheels and Alternators.

The completed power extension forebay, extending 800 ft. from the canal to the river bank, is approximately 94 ft. wide at the surface, its banks sloping to a width of 40 ft. to 60 ft. at the bottom, at an average depth of 14 ft. At its end, where the water enters the flumes, there is a concrete retaining wall containing three gates which are raised and lowered by hand-operated worm gear. In front of the gates is located an inclined steel-bar trash rack carried on I-beams. The penstock flumes leave this concrete wall, into which they are suitably anchored, at different angles, diverging to accommodate the center-line distances of the side-entrance water-wheel cases in the power house below. Each penstock is approximately 230 ft. long and 7 ft. 6 in. in diameter, the upper sections being built of 5/16-in. boiler plate, while in the lower portions this thickness is increased to 7/16 in. The flumes have a slope of 1⅝ in. per foot and are carried at approximately 12-ft. intervals on concrete piers. At the top of the hill, near the

gates, where the tubes pass under a country boulevard and an interurban railway track, the flumes are protected by a reinforced concrete wall arched to carry the earth load.

The present power house comprises the new water-wheel structure, 110 ft. by 30 ft., and the old combination-plant building, 70 ft. by 200 ft., containing the boilers and engines originally installed. The new building has concrete foundations, carried to bed-rock, the walls being of brick, with steel trusses supporting the roof. The present water-power equipment comprises two 26-in. double-runner and one 26-in. single-runner water-wheels. The former machines are of the Allis-Chalmers horizontal type with side entry and center discharge, and each drives, at 400 r.p.m., a 2300-volt, 60-cycle, three-phase Allis-Chalmers alternator delivering 190 amp per phase. The individual exciters are mounted on extensions of the shafts. The speed of these units is controlled by Allis-Chalmers type I oil-pressure governors, with oil pumps belted to the shafts. A small motor manipulated from a double-throw switch on the switchboard enables the setting of the governors to be controlled by the operator. The 26-in. Leffel single-runner double-discharge turbine drives an Allis-Chalmers alternator similar to the other machines, but delivering 115 amp per phase. Its exciter is belt-driven. This Leffel unit is controlled by a Lombard mechanical governor. The average head under which the station operates is 62 ft.

In case of low water or other contingencies this last generator is arranged to be driven by the 600-hp Hamilton Corliss tandem-compound engine through an 8-in. line shaft connected by clutches. This shaft is belted from the 20-ft. engine flywheel. Four 250-hp Stewart boilers are provided for furnishing steam for the engine, and all auxiliary equipment is kept ready for emergency conditions.

Fig. 2—Maumee Valley Combination Water-Power and Steam Plant.

In the concrete foundations carrying the water-wheels are molded the draft tubes to discharge the water leaving the turbine units. These tubes where they leave the turbine cases are round in form and gradually change in shape, so that at the point where the water discharges into the tail-race the section is rectangular. Meanwhile the water has been changed in direction from a vertical drop to a horizontal discharge, and, due to the increasing area of the tube, it is discharged at a comparatively low rate of speed. Owing to the careful attention given these draft tubes the normal vacuum has approached the theoretical, there being a hydrostatic head of 21 ft. from the center of the turbine to the surface level of the water in the tail-race.

In preparing the foundations for the building and draft tubes excavations had to be carried 27 ft. below the power-house level, or approximately 10 ft. below water level, through a very hard flint rock underlying the clay, making progress extremely slow and difficult. In spite of these obstacles and the scarcity of labor, the work, after being started May 9, 1910, was finished so that the complete plant was ready to operate Dec. 26.

Lead-covered cables inclosed in conduit convey the output of the generators and exciters to the switchboard, which is mounted on a concrete platform raised 6 ft. above the generator-room floor and well above any possible high water. The switchboard comprises two exciter panels, three generator panels and three line panels, each complete with phase ammeters and kw-hour meters. Voltmeters and a synchronoscope are provided on swinging brackets. The switchboard, of blue Vermont marble, was supplied by the Allis-Chalmers Company. From the 2300-volt buses the three-phase, 60-cycle energy is raised by duplicate banks of three Allis-Chalmers self-cooling, oil-insulated transformers to the transmission voltage of 13,200 volts. The two transformer banks are arranged for paralleling, through connector switches, to the two line entries for which the station has been designed and the first of which is now installed. From the transformers the lines pass through insulator-mounted choke coils to the entries, being tapped by lightning-discharge paths through General Electric aluminum-cell arresters placed on the gallery above the switchboard floor. On the switchboard balcony is also located a 300-kw, 550-volt rotary converter supplied through a bank of 2300/375-volt step-down transformers. This rotary is employed to feed direct current into the trolley wire of the Maumee Valley belt-line interurban railway, which passes the power house.

Fig. 3—Switchboard Gallery, Showing Transformers and High-Tension Exits.

The 13,200-volt transmission line into the City of Toledo is carried on 40-ft. cedar poles set at 110-ft. intervals on the bank of the old canal, which passes through the city. The single three-phase circuit is made up of No. 1 copper wires mounted on iron-pinned 23,000-volt insulators. The line extends along the canal bank for eight and one-half miles to the lightning arrester and transfer house at Erie Street, where the 13,200-volt conductors are connected to the underground transmission system of the Toledo Railway & Light Company. Within the city limits the wooden-pole height is raised to 50 ft., and at several street crossings 60-ft. steel towers have been used in order to comply with the requirements of the city engineer.

Fig. 4—Placing Penstock Tubes in Position During Construction of New Water-Power Addition to Plant.

As above noted, the Maumee Valley water-power plant is being operated at its full rating continuously to feed into the 18,000-kw steam-power system of the Toledo company, which is

thus enabled to reserve more of its steam-generating capacity for meeting peak loads. The energy thus purchased, in addition to the output of a 5600-kw steam-turbine set just being installed at the main Toledo power house, is made necessary by the rapid increase which the local electricity supply business

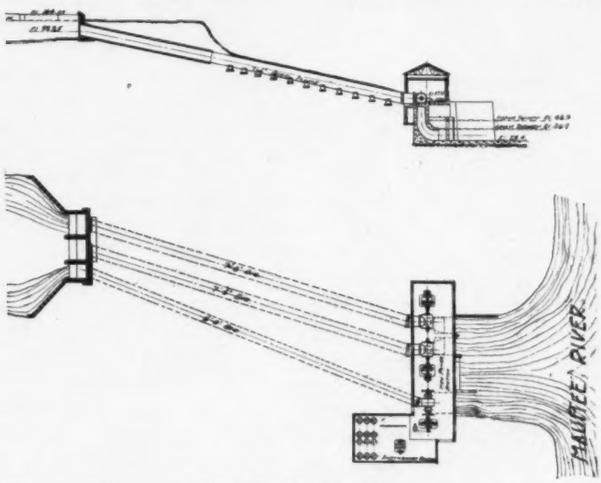


Fig. 5—Arrangement of Forebay, Penstocks, Power House and Tailrace.

has undergone within the last few years. The Toledo steam plant, with which the Maumee water-power works, is also unique among central stations in the variety of steam-engine and steam-turbine types installed and in the number of forms, frequencies and pressures at which the generated output leaves the station.

Besides the present Maumee plant, the Maumee Valley Elec-

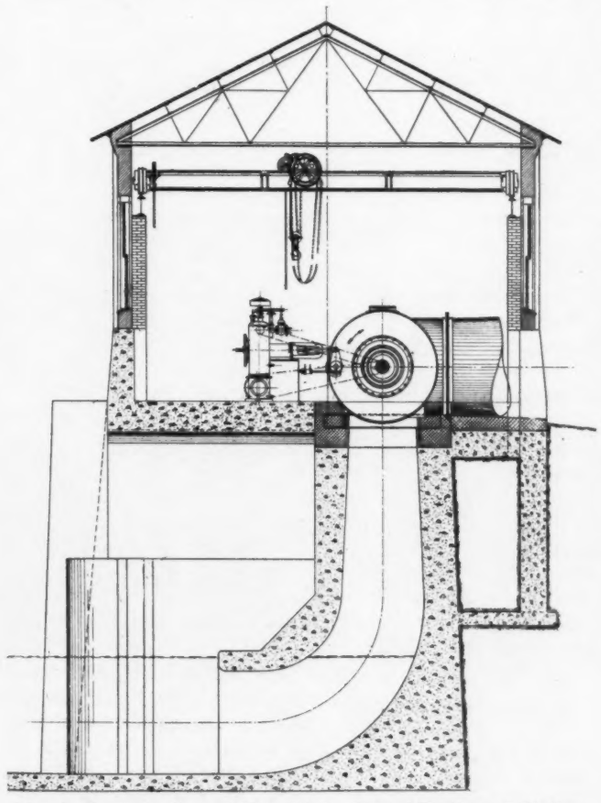


Fig. 6—Cross-Section of New Water-Power Portion of Station.

tric Company has under way plans for erecting three other hydroelectric stations, having purchased all the rights and water privileges necessary for these plants, so that the entire system, when completed, will have a total generating capacity of at least 15,000 kw.

Mr. J. M. Ashley, of Toledo, is president of the Maumee Valley Electric Company, and Mr. H. L. Crawford, of New York, is treasurer. Mr. W. P. Wallace, now superintendent and general manager of the company, superintended the entire construction of the new water-power plant from the plans and specifications of Mr. Robert R. Livingston, consulting engineer, New York City.

The commercial possibility of the low-head hydraulic developments which may be carried out in almost a level country is becoming important, as, for example, the development on the St. Joseph River, in Michigan and Indiana, where there has been installed a generating capacity of about 18,000 kw. The total drainage area of the St. Joseph River is 4500 sq. miles, whereas the total drainage area of the Maumee River is 6700 sq. miles. In all these developments there is a wide difference between high-water and low-water levels and it is found necessary to install several plants in order to develop a large amount of primary power. By this means the period of low water is supplemented by the storage capacity of the dams in connection with each development.

CENTRAL-STATION ICE-MAKING AUXILIARY.

The Present Status of Combination Ice and Electric Plant Operation and Practice.

HEREWITH are presented some significant figures on the present status of ice manufacture by combination central-station plants, taken from a thorough investigation which the *Electrical World* has prosecuted during the past three months. The information here given thus represents the latest data available on the practical matter of this solution of the small central-station's income problem—profitable operation during the light loads of the summer season. The facts adduced seem to show, however, that a goodly number of plant operators have already learned how to convert this indifferently productive summer period into one of the most profitable periods of the year.

As has been pointed out many times in these columns, the combined operation of ice-making and electric generating equipment provides a profitable use for exhaust steam or the surplus power of the station apparatus during non-peak periods, applies to double duty a single investment for real estate, buildings and steam apparatus, and utilizes the same office and plant force to handle both departments of the business. The costs chargeable to each process are thus substantially diminished and margins of profit left which would be impossible in single-utility operation.

ICE-MAKING PROCESSES.

Ice is commonly made by either the ammonia-compression or the ammonia-absorption process. In the absorption system the heat of the steam is used directly to expand the ammonia gas in the "generator," producing in this way sufficient pressure to cause the gas to liquefy in the water-cooled condenser coils. Passing from these the ammonia liquor is then evaporated in the expansion coils, in contact with the brine or material to be chilled, taking up in the process heat which is delivered to the cooling water at the end of the cycle. The steam used to "boil" the ammonia gas can also be condensed and collected as distilled water. This, after being reboiled by passing over steam coils, is used to fill the freezing cans.

In the compression system a motor-driven compressor is employed to produce the pressure at which the ammonia liquefies in the cooling coils. The remainder of the cycle is similar to the preceding system. With such a compressor motor load situated either in the station itself or directly controllable from the switchboard extremely favorable conditions for improving the plant load-factor are established, for the compressor runs long hours daily, but can be slowed down or practically stopped during hours of peak electric demand. The steam and electrical apparatus of the station is thus enabled to operate twenty-

four hours a day at a relatively high technical efficiency, besides carrying a very profitable by-product load. Some of the latest tank plants complete the freezing process in an eighteen-hour to twenty-hour cycle, making an almost ideal "fill" for the broad valley of the daily load curve. The continuous twenty-four-hour electrical service incidentally made possible at a season when electric fans and irons are in demand will do much to popularize the use of electricity in small towns otherwise restricted to night service. Although distilled water from the exhaust will be available for the compression system as before, several processes are now offered designed for using undistilled or "sweet" water where desired. In these compressed air bubbling from the bottom of the tanks agitates the water, clearing the freezing surface of impurities.

In general the absorption system has a higher first cost than a compression plant, is more applicable to the larger sizes, operates more economically and with the expenditure of less fuel, but requires a comparatively large quantity of cooling water to remove the greater amount of heat from the ammonia gas. The compression system, however, is not dependent upon location near the steam equipment for its operation and is in many ways more flexible in its application.

COMBINATION ICE-ELECTRIC PLANTS.

According to the last issue of the "McGraw Electrical Directory" 105 central-station companies report the manufacture of ice, while there are 122 others whose corporate names indicate that ice-making is included in their charter rights, although they have not so reported. The last report of the United States Census Bureau on the electric generating plants of the country declares that 212 combination ice-making plants were in operation in 1907. Taking these lists as a beginning, supplemented by the names of other combination plants obtained from the principal manufacturers of ice-making machinery, letters of inquiry accompanied by stamped return envelopes were sent to all central-station companies whose activities were thought to include ice manufacture. A blank on the inquiry form requested the names of other ice-making stations in the vicinity of the plants addressed, and in this way a number of hitherto unlisted stations were located.

In all 297 companies were addressed, from which 163 replies have been obtained. Of these 146 confirmed the understanding that they were operating ice plants, besides giving a quantity of other confidential information extremely valuable in deducing the practical situation in the industry to-day. Seventeen reported no ice-making auxiliaries, having been incorrectly listed, or having such equipment still in contemplation, or having disposed of their ice interests. With 146 operating ice plants out of the 163 replying to the circular inquiries, it is thus conservative to assume that of the 297 plants addressed there are at least 250 combination ice and electric plants in the country.

LOCATION OF COMBINATION PLANTS.

The distribution of these plants offers some interesting considerations. The stations reporting are located chiefly in the smaller towns and cities, and in conjunction with electric plants of some 50-kw to 500-kw rating. The number of plants in places of a given population is as follows:

Under 2500 inhabitants	48 plants
Towns of 2501 to 5000 inhabitants	48 plants
Cities of 5001 to 10,000 inhabitants	27 plants
Cities above 10,000 inhabitants	15 plants

Ness City, Kan., with a 5-ton ice plant in a community of 750, is the smallest town reporting an ice-making auxiliary.

As might be expected, a number of the plants listed are in the warm Southern States, but nevertheless the list contains some surprises in pointing out the relative number in what are generally considered the Central and North-Central States. Oklahoma is credited with 22 combination plants; Kentucky with 18; Illinois, 16; Missouri, 15; Kansas, 13; Arkansas, 10; Virginia, 8; West Virginia, 5; Colorado, 4; Indiana, 4; Nebraska, 4; Iowa, 4; California, 4; Wisconsin, 2; Connecticut, 2, and New Jersey, 2. Michigan, Nevada, New York, Ohio, Oregon, Pennsylvania, Washington and Hawaii each have one combination plant.

In the South, of course, Texas, with its tremendous and rapidly developing area, has the largest number of ice-electric plants of any state, about 83 being listed. Florida comes next with 17; Tennessee, 8; Louisiana, 7; Mississippi, 5; North Carolina, 5; Georgia, 4; South Carolina, 3, and New Mexico, 3.

The preponderance of plants in the more newly developed states, such as Oklahoma, Texas, etc., is indicative of the progressive character of the electrical industry in those regions. In such new territories modern high-class construction usually characterizes equipment which in more slowly moving and conservative communities is sometimes allowed to lapse far past the point of obsoleteness. The number of combination ice-making plants using their steam equipment to its fullest efficiency is, therefore, only an expected result of the progressive and alert tendencies of these new states.

OPERATING DATA.

A Western company operating a 25-ton plant reports that it is consuming about 65 kw-hours per ton of ice produced, this figure, however, including the refrigeration of four large storage-rooms. After crediting investment and operating costs out of the $3 received per ton the company finds it earns a net rate of about 1.5 cents per kw-hour used. According to the investigations of a leading central-station company from 50 kw-hours to 60 kw-hours are required to produce 1 ton of ice by means of the compression system. The maximum demand of such an outfit reaches 2.3 kw per ton of ice-making capacity per day, of which 1.5 kw is required to drive the compressor itself. Most of the central-station plants investigated use the compression-system equipment.

The ice-making capacity per kilowatt of station rating varies between the wide limits of 1000 lb. to 80 lb. per twenty-four hours. On the average 600 lb. of ice per day can be made per horse-power of engine capacity, but the limit to this ratio revealed by the reports sent in is rather set by the market of the community for ice. However, even such demand is a progressive quantity, for artificial ice is clean and pure, and the habit of ice using once established grows in a community until the demand becomes a profitable one to supply. The number of inhabitants per ton of ice-making capacity was found to vary from thirty or forty to 400 or 500, the majority of the towns reporting, however, averaging 110 to 180 persons per ton of ice-making equipment.

The ice prices reported range from 50 cents to 30 cents per 100 lb. for retail or residential purposes, by far the most popular figure, however, being 40 cents per 100 lb. This rate is often subject to discount to regular consumers, such as soda fountains, saloons, etc., while the wholesale prices go down to from 20 cents to 30 cents per 100 lb.

Most of the plants reporting are operated either continuously throughout 365 days of the year or at least 300 days to 250 days. In the Northern States, of course, this period of operation is reduced to the warm season, and in some instances falls to two or three months. Even within such limits the operation of the ice factory in competition with the natural product has not failed to make the ice investment in certain cases earn a larger yearly profit in ninety days than the all-year-round electric plant in 365 days.

The final question asked of combination ice-plant operators was this: "Has the combination plant proved satisfactory?" Of the replies received 130 were in the affirmative, twenty-four taking occasion to express enthusiasm at the results obtained. Two replied "fairly satisfactory," and four in all answered "unsatisfactory." In two other instances ice plants were reported abandoned from unassigned causes.

The results obtained thus show that, while in four instances ice plants were a disappointment, in more than 130 stations, or 97 per cent of those answering this query, such combination plants have proved signally successful.

USE OF ELECTRICITY ON THE CATSKILL AQUEDUCT.

Large Motor Load on Newburgh Light, Heat & Power Company's Lines Furnished by Contractors.

THE Catskill aqueduct, which will deliver 500,000,000 gal. of water per day to New York City from the 130,000,000,000 gal. Ashokan reservoir in the south Catskill Mountains, will be ninety-two miles long, from the headworks at the reservoir to the equalizing reservoir at Hill View, about two miles southeast of Yonkers and one-half mile north of the New York City line. Four general types of aqueduct construction are employed—cut-and-cover, grade tunnel, pressure tunnel and steel pipe. The pressure tunnels are built entirely in rock with vertical shafts, some of which are permanent waterway shafts connecting the tunnel with the adjacent cut-and-cover or permanent drainage shafts for future unwatering for inspection or necessary repairs. Others are temporary construction shafts which will later be sealed and plugged with concrete.

About twenty miles of this aqueduct is being constructed with electricity supplied by the Newburgh Light, Heat & Power Company, for which work the contractors have a total of 4400 hp in motors installed. The most notable of these installations is that of the Degnon Contracting Company at Forest Glen. This company has the contract for the Wallkill pressure tunnel, the excavation for which is now nearly complete. This tunnel, which is 23,391 ft. long and 14.5 ft. in diameter, is reached through six shafts 350 ft. to 480 ft. deep and electricity is employed as the chief source of power in all the work.

A central distributing plant has been erected by the contractor about 1500 ft. east of the tunnel center line near Shaft 4. Energy at a potential of 33,000 volts is received at this station and the voltage reduced to 2200 volts by two sets of three 300-kw water-cooled, oil-insulated, 60-cycle, single-phase transformers connected in delta. There are five air compressors installed in the station, four of which are each driven by a 500-hp induction motor and one by a 300-hp motor. The motors are three-phase machines operating at 2200 volts and are belted to the compressors. In addition there is a 600-kva, 2200-volt synchronous motor running light on the system to improve the power-factor. The company has a transmission line of its own running along the route of the tunnel over which two circuits are maintained. One is a three-phase, three-wire circuit for the hoists, and the other a circuit for lamps and smaller motors. The energy goes out at a tension of 2200 volts and is stepped down to different potentials as required at the tunnel shafts. Lightning arresters are connected to this four and one-half-mile line every one and one-half miles. The 33,000-volt line over which the energy is received was also erected by the company from New Paltz to the tunnel, a distance of four and one-half miles. This line is identical in construction with the high-tension lines of the Newburgh Light, Heat & Power Company running from Honk Falls to Newburgh over the Shawangunk Mountains.

The total energy consumption for all purposes as metered at the central plant last July when all the headings were working was as follows: Compressors, 25,300 kw-hours a day; hoists, 2780 kw-hours; lamps, blowers, electric locomotives and pumps, 1570 kw-hours; making a total daily consumption of 29,650 kw-hours.

Fig. 2—High-Tension Line at Forest Glen Crossing.

The power house, a building with steel-roof trusses and corrugated steel roof and sides, covers a ground area of 80 ft. x 160 ft. and is located a short distance from the Wallkill Valley Railroad, a single-track branch line which furnishes the only transportation in the vicinity. Adjacent to the plant is a small stream across which a sheet-pile dam is built to form a pond from which to take water for cooling the compressed air and the transformers. The hot water is discharged into the pond again, but at some distance from the intake, so that cool water is always available. The synchronous motor already mentioned is equipped with a 6-kw exciter on the same shaft. In view of the large induction motor load the contracting company is under agreement to operate this machine as a means of improving the power-factor and to help the regulation on the Newburgh system. A drop of 80 volts was noted on the Forest Glen board when the synchronous motor was not in operation, showing that the motor takes care of a large inductive drop. With the motor off the line a number of readings were taken extending over several hours and an average power-factor of 83 was found on a load ranging from 700 kw to 1000 kw. At this power-factor the synchronous motor absorbing about 45 kw will easily take up the wattless component on the average load,

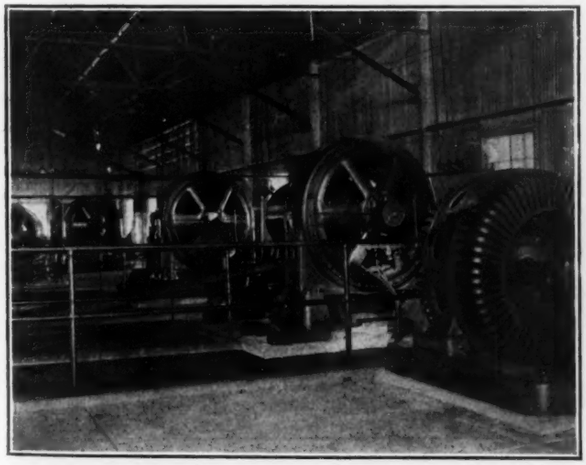


Fig. 1—Induction Motors Driving Compressors in Degnon Contracting Company's Station at Forest Glen, N. Y.

Fig. 3—High-Tension Transformers in Operation at the Forest Glen Station.

which ranges about 875 kw, and thus keep the power-factor near unity.

At each of the six shafts are two elevators or hoists operated by a 150-hp, 2200-volt, three-phase induction motor. The hoist is capable of a speed of 500 ft. per minute and is located in a shed adjacent to the shaft. Solenoid brakes set automatically if for any reason the supply of energy is interrupted. There are also automatic switches on the headframes to prevent overwinding. The shed at Shaft 4 also houses a 10-kw motor-generator set for supplying direct current to a trolley system in the tunnel. There are four of these sets in all, located at as many shafts for this purpose. At Shaft 4 are also installed three 20-kw transformers for stepping down the potential from 2200 volts to 220 volts for use in lamps and motors. To one side of the shaft is a concrete mixing plant operated by a 30-hp motor, and in connection with this plant there is a motor-operated hoist rated at 22 hp. The 30-hp motor is a trifle large for the work intended, but the company had it on hand and applied it to a 15-hp load rather than invest in a smaller machine.

The mine locomotives used are six in number and are operated by 15-hp motors. These have given excellent satisfaction in removing rock to shafts and pulling concrete for lining the tunnel. They are also economical in operation. At each shaft electrically driven centrifugal blowers are provided for ventilation. The blowers at the two heading shafts have a capacity of 7500 cu. ft. of free air per minute at a pressure of 6.5 oz. By blowing compressed air into the heading while blasting and for a short time afterward in conjunction with the blowers smoke troubles are obviated. The tunnels are lighted by 16-cp lamps spaced about 25 ft. apart with extra portable lamps in heavy lamp guards at working faces. The portable lamps are removed when blasting is about to take place and the firing of the blast is done with the 220-volt lighting circuit. The shoot wires are strung on the opposite side of the tunnel from the lighting circuits and the connections and firing switch are placed 500 ft. back from the heading. The cut as well as the other bench holes are wired in series.

For the purpose of taking care of seepage electric and air-driven pumps are installed. There are two three-stage, 100-gal. centrifugal pumps operated against a 400-ft. head by 30-hp. motors and four 200-gal. pumps each driven by a 50-hp motor. The electric pumps are operated for short periods only, being held in reserve for emergencies. At the Bonticou substation, from which energy on the cut-and-cover aqueduct running around the ridge of the mountain from the tunnel to the next

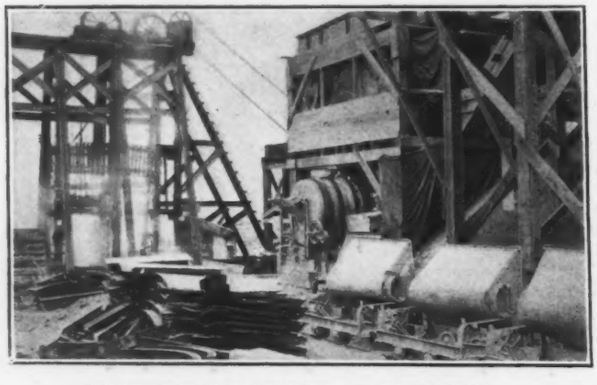


Fig. 4—Concrete Mixer Cars and Head Frame.

contract, is supplied the company has installed 300 kw in transformers for stepping down the potential from 33,000 volts to 2300 volts. A 150-hp compressor outfit is located at this substation and the rock crushers and concrete mixers used on this section have their motors also supplied with energy from this point.

Two miles northwest of Stone Ridge is the Atwood station of the seven-mile aqueduct section which the H. S. Kerbaugh Company is building. A four-mile, 33,000-volt line runs from the High Falls substation of the Newburgh Light, Heat & Power Company to Atwood, where it enters a 50-ft. x 80-ft. power house. Here three 300-kw transformers reduce the voltage to 2300 volts, at which pressure two 300-hp motors drive air compressors, the output from which is used chiefly for drilling. A 2300-volt line runs north to the machine shop, where a 30-hp motor is installed, and another 2300-volt line supplies energy to a "mixer" on which are installed motors aggregating 220 hp. Several miles north of the Atwood power

Fig. 5—Substation at Bonticou.

house are a 200-hp motor-driven stone crusher and two 30-hp mixing motors. The total load aggregates 850 kw.

Part of the Kerbaugh contract consists of nearly five miles of cut-and-cover work and on a portion of this a most interesting portable plant is employed, although the plant is not now in operation, having been shut down for the winter. The concrete aggregates are mixed dry at the crusher plant at the north end of the contract and brought to the portable mixing plant. Cement is added here and the concrete is mixed on the flat car. A small derrick is located on the car for handling the stone and cement from the material train. The mixer discharges the concrete into a chute which carries it out over the trench. No extra grout is used in finishing the invert, a 2-in. steel shaft about 16 ft. long being used to roll the surface. The balance of the concrete work is performed by the main

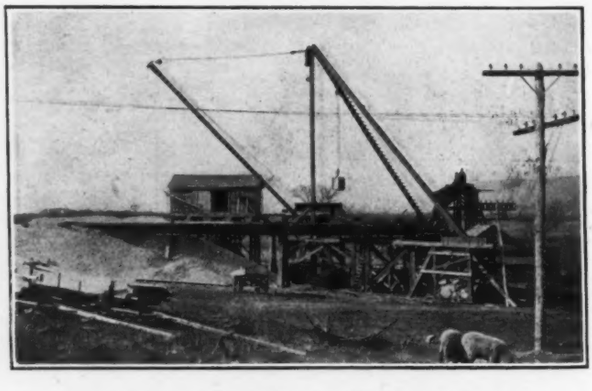


Fig. 6—Concrete Mixing Plant at Shaft.

plant, consisting of two principal parts. The first is the crushing and mixing plant and the second part serves both to handle the concrete and the outside forms.

The first part comprises a steel framework mounted on two 60-ft. steel cars placed side by side which run on two standard-gage tracks on the curve of the invert. From the crusher on the floor of the car a 16-in. bucket conveyor carries the material to a revolving screen at the top of the plant. The stone rejected here passes through a crusher and sand rolls and is

again dumped into the conveyor and revolving screen. Below the sand and stone bins, which hold 40 cu. yd. and 20 cu. yd. respectively, are the measuring hoppers and a mixer. The mixer dumps into buckets which are picked up by electric hoists and carried to the forms. Each of the two buckets used for handling the concrete has four wheels fastened to the rim for operation on a short track which supports it while being filled from the mixing spout.

The part of the plant used in placing the concrete and handling the outside forms consists of a two-truss steel bridge 140 ft. long upon which travel the several hoists for performing the various operations. The traveling hoist for handling the concrete buckets is suspended beneath the bridge and is equipped with one 11-hp motor for hoisting and two 3-hp motors for propelling. Three sets of track are provided for this carriage so that when the machine is being operated around a curve that set of tracks is used which will suspend the carriage more nearly over the top of the work. On top of the bridge is another traveler provided with overhanging arms to which chain hoists are attached for handling the outside forms. The traveler is equipped with two 5-hp motors. Another chain hoist is provided at the rear support of the bridge and this is also equipped with a 5-hp motor. The hoists are suspended from an I-beam over the center line of the aqueduct. The saddles, each of which is 2 ft. wide, are picked up by the hoist, turned 90 deg. and carried forward through the supporting frame and

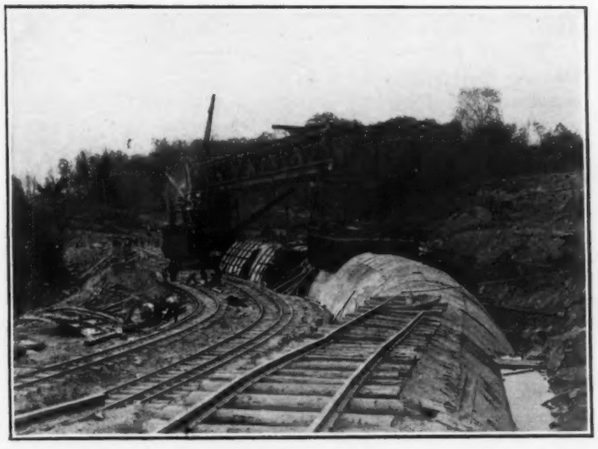


Fig. 7—Electrically Operated Rock Crusher, Concrete Mixer and Concrete Placer.

reset ahead. When several saddles are set ahead the entire plant is pulled forward. This process is repeated about five times in moving 60 ft.

The forms used on the work are of sheet steel braced and built to fit inside the perimeter of the aqueduct. These are made in 5-ft. lengths and are hinged at a point about 2 ft. above the invert. The bottom 2 ft. of the forms can thus be turned in on the hinges and the entire form supported on an A-frame carriage. The carriage is equipped to run on a standard-gage track and is operated by a 30-hp motor. Fifteen feet of forms is handled by the carriage at one time.

Two tracks parallel the line of the aqueduct work upon which the stone and sand are brought in wooden skips, the latter being handled by electric derricks. The concrete work for 60 ft. of arch is started in the morning and carried to completion. This usually requires seven hours, when about 171 cu. yd. of concrete is poured. There are in use 180 ft. of inside forms, 60 ft. being concreted, 60 ft. being under green concrete which supports the saddles and 60 ft. of forms being moved. Of the outside forms 120 ft. only are used. The greatest dimensions of the aqueduct, which is shaped somewhat like a horseshoe, are 17 ft. x 15 ft. The thickness of concrete averages 2 ft. The "mixer" shown in Fig. 7 combines all the functions of concreting, mixing, forming and laying the material.

THE CENTRAL-STATION MOTOR LOAD.

The Extension of Electric Motor Service in New England.

ELECTRIC MOTOR SERVICE AT FITCHBURG, MASS.

The Fitchburg Gas & Electric Light Company, serving a population of about 40,000 persons, has a connected motor load of about 1720 hp. Energy is supplied to miscellaneous industries in the city, and in the past three years the company's connected motor load has been supplied mainly from a steam plant equipped with compound condensing engines and direct-connected alternators. Recently the company entered into an agreement with the Connecticut River Transmission Company whereby an interchange of energy takes place according to local conditions on each system. At times of a shortage of power due to low water the central station supplies energy to the transmission system reciprocally upon an agreement by which the latter sells electricity to the Fitchburg company when the supply is available and the load requirements suitable. The Fitchburg company now has about sixty-four customers using energy for motor service only. The rates in force encourage long-hour consumption, and the load-factors in some of the industrial plants driven by motors are excellent.

In the summer season the company operates a brickyard equipped with a 50-hp motor of the induction type. This service begins as soon as the frost leaves the ground and stops when the freezing weather sets in, and is attractive on account of its absence from the yearly peak. At certain periods some of the motor-driven machine shops in the city run night and day. An all-night service is supplied in a number of comb shops in the driving of tumblers by 5-hp motors and larger sizes. Another customer of the company is a grain mill equipped with two motors totaling 80 hp. The maximum demand of this installation is 80 hp. Two afternoon newspapers are run by electric motors, the service requiring a connected load of 11 hp in one case and 15.5 hp in the other. This load comes off the lighting peak in almost all cases. In a prominent machining establishment equipped with fifty-three motors, with a combined rating of 275 hp, the maximum demand measured by the lighting company has been about 100 kw, and in another similar competitive establishment with forty motors, having a total rating of 100 hp, the maximum measured demand has been 30 hp. In a further case of this kind a machine shop equipped with motor-driven high-speed lathes has ten motors, with a total rating of 115 hp, and the maximum demand noted has been 80 kw. A fourth instance, having in the plant twenty-two motors, mainly of ½-hp and ¼-hp rating, and a total rating of 29 hp, has a maximum demand of about 11 hp. These results, favorable to central-station service, are largely due to the use of individually driven electric motors in the industrial plants, while the owner gets the benefit of taking energy only while he is actually performing productive work in his factory or shop.

TWO SUGGESTIVE CENTRAL-STATION LOAD CURVES.

The influence of a substantial motor load upon central-station output is well illustrated in the two accompanying load curves of the East Bridgewater station of the Edison Electric Illuminating Company, of Brockton, Mass., for two days in the latter part of 1910. In the past three years, between June 30, 1907, and June 30, 1910, the connected motor load of this company, which is one of the Stone & Webster group, has increased from 627 hp to 3480 hp. There is now about 1 hp of connected load for every nine inhabitants of Brockton, which is a prominent shoe manufacturing city about twenty miles south of Boston. Electric service at Brockton and throughout the adjacent district is now supplied from a turbine station of the company at East Bridgewater, the benefits of centralization having been demonstrated by the shutting down of the former small and relatively inefficient steam stations in Brockton and adjacent towns and the inauguration of a single and comprehensive service from the turbine plant. An eight-hour day is the rule in the Brockton district, and the results are somewhat

favorable to central-station investment economy, since there is very little overlapping of the peaks except in the few darkest weeks of the year and even then the overlapping is of short duration.

Fig. 1 shows a typical load curve of the East Bridgewater station, the readings having been platted for Friday, Sept. 16, 1910. The flat character of the curve throughout the day and the absence of any pronounced afternoon peak are significant.

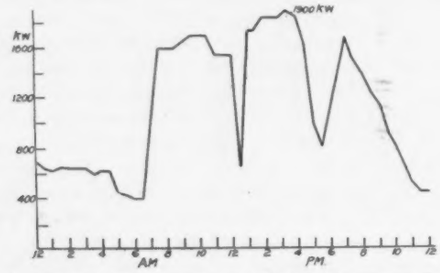


Fig. 1—Typical Load Curve of East Bridgewater Station.

The maximum reading during the day on the station output was 1900 kw, or about 300 kw above the average of the forenoon and about 150 kw above the early afternoon average. Curve 2 shows the load on this station during the extreme peak of the year, on Thursday, Dec. 15. Although the excessive lighting demand is evident, rising to a total output of 2900 kw for both lamp and motor service, the influence of the motor load during the day is clearly favorable. The duration of the extreme yearly peak was not much over two and one-half hours, and it was well within the rating of the station, which contains two 1500-kw Curtis turbo-alternators. For the year ended June 30, 1910, the load-factor of this station was 33.3 per cent and the station factor was 30.7 per cent.

ELECTRIC MOTOR APPLICATIONS AT QUINCY, MASS.

Off-peak electric motor service business has attained a substantial development at Quincy, Mass., where the Quincy Electric Light & Power Company supplies about seventy-seven customers with energy for motor service in connection with the operation of granite sheds. Quincy is a suburban city in the Boston district, with a population of about 32,000 inhabitants. The company's connected motor load on June 30, 1910, was 1030 hp. The service is very attractive from the central-station standpoint, since the consumption of energy is practically

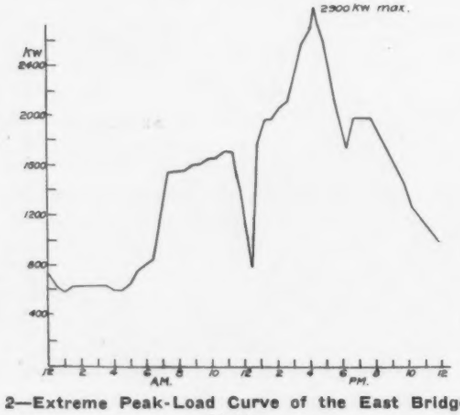


Fig. 2—Extreme Peak-Load Curve of the East Bridgewater Station

always stopped by 4:30 p. m., the hours of the granite industry being from 7 a. m. to the above time. All the motor service in Quincy is of the alternating-current type, so that the company has the opportunity to utilize its generating equipment for the motor work in the daytime and for lighting service during the evening and night. The demands of individual installations are also relatively large and well sustained, and only very small amounts of steam are required in the industry.

Among the representative stone sheds at Quincy equipped for electrical operation is that of Hughes & Johnson. This house manufactures granite monuments and has two motors in service, one being a 50-hp outfit and the other a 35-hp unit. The larger motor is installed in a shed on the premises and arranged to drive an Ingersoll-Sergeant double-acting compound air compressor capable of delivering 215 cu. ft. of air per minute at about 90 lb. per square inch, and also a Mead-Morrison electric derrick of 20 tons rating. The motor is equipped with a 14-in. pulley which is belted to a 54-in. countershaft pulley, and from the countershaft the compressor is belted off a 36-in. pulley and the hoist off a 40-in. pulley. The compressor operates continuously and the derrick intermittently, the motor being of sufficient size to handle both temporarily. The derrick has a 49-ft. boom, and in the stoneyard which it serves are two surfacing machines, drills, etc., which are operated by air from the motor-driven compressor. In the finishing department of the plant are a 10-ton traveling crane, a pump for washing stone by means of water from an adjacent well, and three polishing machines, all group-driven by the 35-hp motor. Energy is supplied to the establishment for motor service by a three-phase, 550-volt, 60-cycle overhead circuit carried to the plant from a distributing transformer installation on a pole about 100 yd. distant, as shown in the accompanying photograph. The lighting company has adopted the policy of carrying its 2300-volt service to local distributing centers only, instead of to all customers, the centralization of distributing transformer equipment being very attractive and the losses light for the short distances over which the 550-volt energy is locally transmitted in each case.

Among other prominent stonecutters using electric motors in Quincy are Milne & Hector, equipped with two 50-hp motors, one of which is usually sufficient to carry their fluctuating loads; E. H. Doble & Company, 50 hp; Monohan Granite Company, 50 hp, and J. L. Miller, F. Barnicoat and F. Craig Company, 50 hp each.

One of the most interesting applications of electric motors in eastern Massachusetts is at Quincy Adams station, in the city of Quincy, the principal shipping point of all the granite produced in the territory. The handling of heavy freight between trucks and railroad cars is accomplished here by the use of a 40-ton Shaw electric traveling crane spanning a combined railroad yard and teamway, as shown in the accompanying

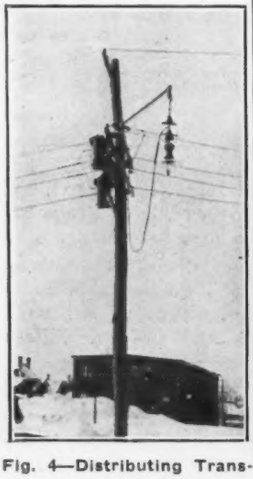


Fig. 4—Distributing Transformer.

Fig. 5—Electric Crane in Freight Yard.

photograph. The crane was installed by the New York, New Haven & Hartford Railroad Company for the purpose of expediting the handling of heavy freight, the former work having been done at another station in the vicinity which was equipped with a slower and less convenient steam derrick of smaller rating. The present derrick, which was supplied by the Shaw Electric Crane Company, of Muskegon, Mich., operates both horizontally and vertically, and travels north and south in the

yard for a distance of 160 ft. The crane consists of a heavy steel girder structure carried on posts terminating at their bottoms in channels carried on wheels capable of running back and forth in a track of about 50-ft. gage, which is the span of the crane. The hoisting mechanism of the crane is installed in

Fig. 6—Electric Crane in Freight Yard.

a covered structure on top of the main crane girder, and there are two 50-hp motors in service. The motors are operated by three-phase, 550-volt energy supplied by three horizontal trolley wires carried along the travel of the crane on wooden posts,

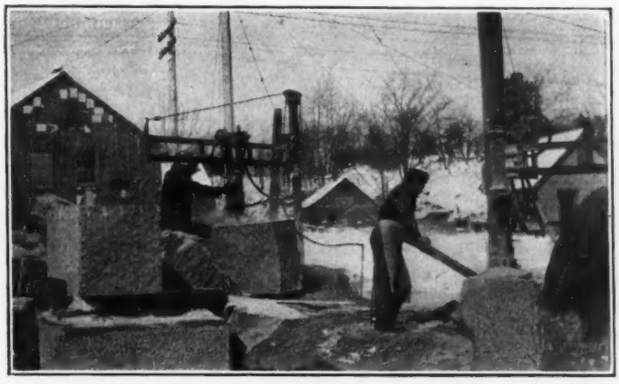


Fig. 7—Electrically Operated Granite-Cutting Plant.

as shown herewith. The energy consumed by the crane is metered in a pole box at one side of the runway, and the lines on the station side of the meter are the secondaries of step-down transformer equipment installed at a center of distribution

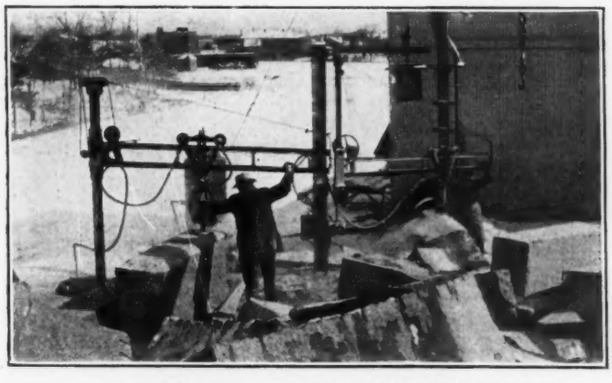


Fig. 8—Motor-Driven Granite-Cutting Machine.

in the neighborhood. A main switch and fuses are mounted in the meter box. The crane is controlled from a cab hung from the main girder at one end, and it is in service on week-days from 7 a. m. to 12 a. m. and from 12:30 p. m. to 4 p. m. By its use eleven freight cars can be loaded without shifting. The busiest season is from March to November.

CENTRAL-STATION ELECTRIC MOTOR SERVICE AT WORCESTER, MASS.

The Worcester (Mass.) Electric Light Company serves one of the most prominent manufacturing cities of the East, and illustrates in a marked degree the benefits of motor-load expansion, both to the company itself and to the community. In 1907 the connected motor load of the company was 1449 hp and the income from this service was $44,596. In 1910 the connected motor load totaled 2070 hp and the company earned from this service in the year ended June 30 last $66,000, or a gain of practically 50 per cent in revenue. The influence of this increase upon the economy of the generating station of the company is noticeable in a reduction of operating cost at the busbar, exclusive of fixed charges, by approximately ¼ cent per kw-hour. .

Among the larger customers to which the company now supplies energy are the following: Worcester *Telegram*, about 150 hp connected motor load; J. B. Garland & Son, grain elevator, 115 hp; Worcester Brewing Corporation, 300 hp; Crompton & Knowles Loom Works, 300 hp in group drives; Cudahy Packing Company, 15 hp, refrigeration load; Worcester Market, refrigeration and miscellaneous service, 50 hp; W. H. Leland & Company, grinding machinery, summer night work frequent, about 100 hp. The newspaper load above cited occurs mainly during the small hours of the night and is influential in placing a better load on the station at a time which is usually rather devoid of motor load. The city sewer department operates three automatic electric pumping stations. At the Gold Street station are two 5-hp, 500-volt motors arranged in duplicate for operating a 4-in. centrifugal pump with a lift of about 9½ ft. At the Lake View station are two 15-hp motors arranged in duplicate for the operation of air compressors in connection with Shone ejectors lifting sewage by three stages 180 ft. At the Highlands pumping station are two 5-hp motors operated in connection with compressors and a Shone ejector lifting sewage 65 ft.

GROWTH IN CENTRAL-STATION MOTOR SERVICE AT LOWELL, MASS.

Rapid growth in the central-station motor-service business has been a feature of the electrical situation in Lowell, Mass., during the past three years. In the year ended June 30, 1907, the Lowell Electric Light Corporation sold 2,196,736 kw-hours for motor service and derived from this a revenue of $76,651. In the corresponding fiscal year 1910 the company had a connected motor load of 8250 hp, compared with 5071 hp in 1907; its motor-service income was $160,588 and the sales of energy for motor service were 6,336,052 kw-hours. There is now 0.9 hp of connected motor load in Lowell per inhabitant. The present day load on the company's station is from 3500 kw to 4000 kw. The company's load-factor is running between 33 per cent and 38 per cent. On account of the limited amount of water in the Merrimac River, which flows through the city, the company is taking up the supply of electricity to textile mills with a considerable measure of success.

ATTRACTIVE NEWSPAPER MOTOR LOAD AT BOSTON.

One of the latest motor load acquisitions of the Edison Electric Illuminating Company of Boston is furnished by the Boston *Herald*, a daily newspaper of long-time prominence in the life of the city. The *Herald* owns one of the most completely equipped electrically driven plants in the country. Electrical energy was formerly generated in the *Herald* building by a gas-engine plant operated from the local city service, but a recent change in management, combined with a thorough study of the requirements by the Edison company, has led to the shutting down of the gas-power equipment and the entire adoption of central-station service for both lighting and motor service.

The *Herald* plant is located in a special building at the rear of the newspaper commercial offices. The importance of the electric drive in permitting rapid production of fresh editions led the management of the paper to install an extensive individual driving service for the separate machines. Out of an

entire page of eight columns in the paper perhaps only one-half column may be set by hand. Motor-driven machinery is installed at every step. Three 55-kw and one 25-kw gas-engine units are superseded by the Edison service. The plant contains one Hoe color press and four Hoe sextuple presses, the latter being driven in each case by a 4-hp motor for slow motion and a 50-hp motor for regular production. Jenney control appliances are provided in connection with the press motors, so that push-button operation is all that is required in the pressroom. The presses are started with the small motors and then operated by the larger ones. Motor-driven starting boxes are provided, and the equipment is arranged to cut in the resistance automatically in case the supply of energy is cut off temporarily. The motors are installed in concrete pits below the presses. The total rated output of the plant is about 375,000 eight-page papers per hour. The larger presses are capable of printing ninety-six-page issues. Electric hoists are used in the pressroom in handling the rolls.

A list of the principal equipment follows:

Stereotype Room.—Matrix roaster, ½ hp; three tail cutters, each, 5 hp; two curved shavers, each, 2 hp; one flat shaver, 3 hp; one jig saw and drill, 1 hp; one flat router, 1.5 hp; one bending machine, 2 hp; two curved routers, 2 hp each; one saw and beveler, 1 hp; one sump pump, 3 hp.

Machine Shop.—Speed lathe, back-geared to ¼-hp motor; one circular saw, 5 hp; one engine lathe, 1 hp; one emery grinder, ½ hp.

Composing Room.—Twenty-seven linotype machines, each equipped with a ¼-hp motor arranged to start when the operator takes his seat; two sets of field coils on each motor and three speeds of machines, 70 r.p.m. to 74 r.p.m.; maximum setting capacity, 9000 ems per hour each. Copy carrier in composing-room, ½-hp motor; three copy carriers serving proof-readers' desks, ½ hp each; two matrix rollers, each 3 hp; matrix endless-belt conveyor to basement, 2-hp motor; one lathe for line work, ⅔ hp; one metal saw, 1 hp. Cuts are handled by push-button elevator, motor-operated.

Engraving Department.—Two powdering machines, 3 hp each; two etching machines, each 3 hp; one saw and trimmer, 2 hp; two flat routing machines, 20,000 r.p.m., one ¼ hp each.

Mailing Room.—Four conveyors, back-geared to 2-hp motors; job presses, ¼-hp and ⅓-hp motors; addressograph, ⅓ hp.

The larger part of this work is handled either during the daytime or in the night hours of the early morning off the main peak of the service. Several other newspapers in Boston are operated by motors receiving energy from Edison circuits.

ELECTRIC MOTOR SERVICE AT CAMBRIDGE, MASS.

Long-hour motor service has been cultivated to a large degree by the Cambridge Electric Light Company within the past two years. A specially advantageous load of this character has been furnished by the Cambridge subway, which is now rapidly approaching completion under the hands of the H. P. Nawn Contracting Company, of Boston. The subway is being built by the Boston Elevated Railway Company. The uses of electricity in its construction were described in the *Electrical World* of July 28, 1910, the load being particularly desirable on account of its being on the system twenty-four hours per day and seven days per week. The demands for electricity have naturally dropped off somewhat with the completion of some of the heavier work, but the company is still supplying continuous service to a limited extent. Among the large customers now using the company's service are the John P. Squires Packing Company, 1200 hp, with about 600 additional horse-power to be added shortly; the Boston Woven Hose Company, 1000 hp; the Riverside and University presses, about 130 hp each; the Wood Lumber Company, 160 hp; C. F. Hathaway & Son, bakers, 85 hp to 100 hp; John Cross & Company, owners of a new shoe factory, 175 hp, and the Manhattan Market, about 50 hp.

The above loads are either of the off-peak or long-hour type for the most part. The bakery load is largely carried during the night; the woven-hose establishment operates a night shift at certain times, and the two large printing plants are operated almost entirely on a day basis. At the Squires plant a heavy refrigerating load is carried in the summer season, with a considerable amount of energy utilized much of the time in the butchering and box departments. The Manhattan Market is the largest in the city, and is one of the best equipped in the State from the electrical point of view. In addition to the usual meat, fish and delicatessen departments the market does a large business in the sale of dairy products, fruit, canned goods and kitchenware. Most of the motors are of the three-phase induction type, operated on a 550-volt circuit. The most important mechanical service performed in the market is refrigeration, and the Manhattan plant is equipped with a 7.5-ton York ice machine belt-driven by a 15-hp motor, together with a Dean vertical triplex brine pump having a rated output of 90 gal. per minute. In one of the first years of this plant's service the cost of operation by electricity was $2,600 less than when the market used ice, energy being supplied at 2.5 cents per kw-hour and ice being sold at about $3 per ton. It has been found that cuts of meat exposed in the cooled showcases remain drier and in good condition much longer than under the old method of ice cooling. Small fan motors are used to circulate air in the cooled rooms, and the ice boxes are electrically lighted. Other equipment in the plant includes a coffee mill driven by a 1.5-hp motor, a ventilating fan driven by a 0.5-hp motor for the main cold chest, a 2-hp Enterprise meat chopper, and a complete system of parcel and stock conveyors operated by a 7.5-hp motor. The conveyors carry the parcels from the counters to a checking desk and thence to an assorting-room in the basement, where all outgoing orders are assembled for team delivery. After the orders are assembled they are carried to the first floor by a conveyor and transferred to the shipping wagons. Each conveyor is a continuous belt and all empty parcel boxes are returned automatically to the sender. All conveyors are 17 in. wide. The 7.5-hp motor above mentioned drives the conveyor between the first floor and basement by worm gearing, and by means of a countershaft the same motor also drives an elevator used for handling heavier articles between the receiving department and the street floor. The latter hoist is specially equipped with lugs to handle barrels and has a rating of 600 lb. A belt conveyor is also provided in the plant between the shipping department and the first floor. This has a rating of 100 lb. and is driven by a 1-hp motor. Electricity has been in use in this market about five years. The proprietors are thoroughly convinced that central-station service is the most economical and efficient for their work, and enlargements of the establishment are certain to be operated by electric motors.

ELECTRICITY IN AN AUTOMOBILE-SERVICE DEPOT.

Electricity is extensively used in the largest automobile-service depot in New England, which is that of the Packard Motor Car Company at Boston. About a year ago this establishment was opened to the public under the management of Mr. Alvan T. Fuller. It is located on Commonwealth Avenue in the Allston district of Boston, and consists of a four-story and basement reinforced-concrete building, 352 ft. long x 70 ft. wide, entirely devoted to the garaging, assembly, sale, display and maintenance of automobiles. The structure was erected at a cost of about $300,000; about 300 persons are employed in it and about $1,000,000 worth of high-grade cars can readily be stored in the building at any one time. The electric service of the building is supplied by the Edison Electric Illuminating Company of Boston and it is in the main of the off-peak type, the plant shutting down daily at 5:30 p. m.

The electric motor installation includes about a dozen machines of the induction type scattered throughout various departments, in general operating the equipment on the group-driving basis. The first floor of the building is equipped with facilities for handling a large number of quick-repair jobs, a large corps of expert testers always being available, and it also includes an electrical department where magnetos and batteries are given particular attention by specialists. On this floor the

battery and magneto-room is equipped with a ⅛-hp motor which drives a magneto and coil tester, and a U-shaped helix is also provided for the magnetization of permanent magnets in magneto apparatus. This coil takes 5-amp at 110 volts direct current, the supply being taken from a mercury-arc rectifier, which is also used in charging sparking batteries The electrical department is connected with the other floors of the building by a Burdett-Rowntree double dumb-waiter installation, each waiter being driven by a 4-hp motor. The waiters pass through the center of the stockroom department, where are stored supplies valued at about $200,000, maintained for the benefit of the owners of these cars. The waiters are of the automatic type with push-button operation for different floor stops.

The repairing facilities on the first floor of the building include a small machine shop with the tools driven in group by a 2-hp, 220-volt induction motor. The machine tools thus operated include a twist drill, lathe and grinder. On this floor is a portable tire pump driven by a short belt from a 1/6-hp, 110-volt induction motor. All the floors of the building are connected by an electric elevator of about 8000-lb. rating driven by a 25-hp motor. With this equipment two of the largest automobiles may be lifted simultaneously to the top floor of the establishment. Space is provided in the building for the installation of a second elevator of this rating when necessary. The entire plant is equipped with an automatic telephone call-bell system which rings the gongs on each floor according to a prearranged signal when any officer of the establishment is required at the wire. An electric time-program clock is also in service.

The top floor of the building contains the overhauling department, which is one of the most extensive of its kind in the world. A large part of the company's business consists in the modernization of cars of a former year's production. The overhauling work is segregated into divisions for the handling of rear end, clutch, steering, motor, carburetor and other portions of the motor vehicle, and the floor of the building is clear of posts, giving a maximum efficiency in the working space. On this floor is a coach department in which the most complete body repairs can be handled, including both upholstery and carpenter work, whether the bodies are of wood or aluminum. On this floor is a machine shop equipped with three lathes, a grinder, two drills and a forge blower driven in group by a 7.5-hp induction motor mounted on a steel framing attached to the concrete wall of the department. To meet the insurance requirements a blacksmith shop on this floor has been installed substantially on the outside of the building, with wired glass and other fireproof construction separating it from the repair division proper, including a separate entrance. The blacksmith shop contains three forges supplied with air by a blower located inside the overhauling department.

The third floor contains an enameling department, wheel-building machinery, a paint shop and upholstery division, with woodworking shop. Two 1/6-hp motors are in service in connection with the individual driving of heavy sewing machines for upholstery work. The woodworking plant consists of a band saw, grinder and stone driven by a 3-hp motor, one or two other special machines being provided on the same counter-shafting. The benches in the upholstery department are arranged so that the operator sits in a recess and faces the length of the bench rather than its width. In the basement of the plant are two 2-hp motor-driven drainage pumps, the motors being of the induction type. All the energy for the building is drawn from a transformer on the outside, which is connected with the Commonwealth Avenue substation service of the Edison company. A three-panel switchboard equipped with Wright demand meters is in service on the first floor. All the wiring is carried in iron conduit, and the establishment is equipped with fifty mercury-vapor lamps of the 4-amp, 100-watt size. The paint shop is lighted by tungsten lamps, which are used in the offices also. A large electric sign installation will shortly be made on the roof. Mr. C. A. Jacobs is chief electrician, Mr. A. P. Wilburn is assistant superintendent and Mr. R. H. Bolles is superintendent of the establishment.

ELECTRICITY ON BARGE CANAL WORK

Contractors' Construction Plant for Deepening and Widening the Present Erie Canal at Lockport.

THE New York State Barge Canal consists of an enlargement and relocation of the present Erie and Oswego canals so as to accommodate barges of 2000 tons capacity. The improvements, which were authorized by the State Legislature in 1903, are estimated to cost $101,000,000. The total length of the improved canals, including the Champlain Canal, is 433 miles and the section replacing the Erie Canal from Troy to Buffalo will be 353.5 miles long. Many of the contractors engaged in the work along this branch of the barge

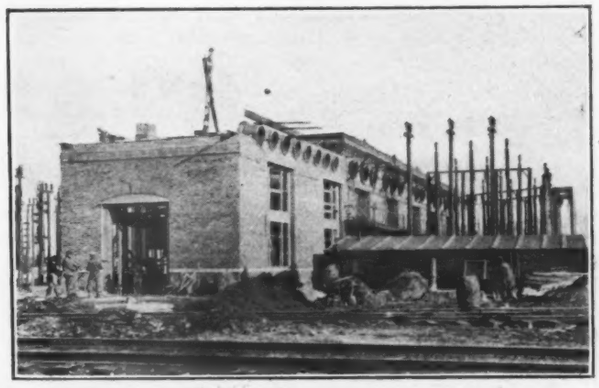


Fig. 1—Contractors' Annex to Niagara, Lockport & Ontario Power Company's Substation.

canal employ electricity to a greater or less extent, and a notable installation at Rochester was described in these columns a year ago. From a point a few miles west of Rochester to the Niagara River the work of enlargement involves the present Erie Canal and includes in its length a sixty-mile level between Rochester and Lockport. Through this section of the canal the traffic is a maximum and the terms under which the work is

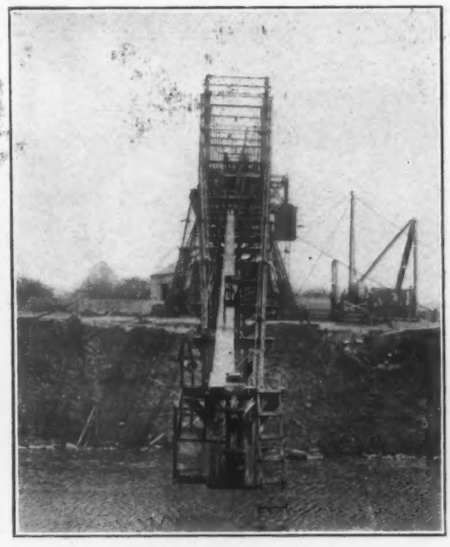


Fig. 2—End View of Cantilever Crane.

being done require the maintenance of the channel throughout the season of navigation, from May 15 to Nov. 15. During the rest of the year the water is out of the canal bed, enabling work to be carried on in the dry.

The section immediately west of the sixty-mile level and extending from Lockport to the guard lock at Sulphur Springs, a distance of about five miles, is being enlarged by the United Engineering & Contracting Company, of New York City, and

will be completed in the spring of 1912. A feature of the construction work is that electricity is employed throughout except in the steam shovels, and the work involves a connected load of some 2000 hp used twenty-four hours a day. The field headquarters of the company are at about the mid-point of the contract section between the canal and the Buffalo, Lockport & Rochester Railway, the electric line over which supplies and machinery are brought. The group of buildings near the canal

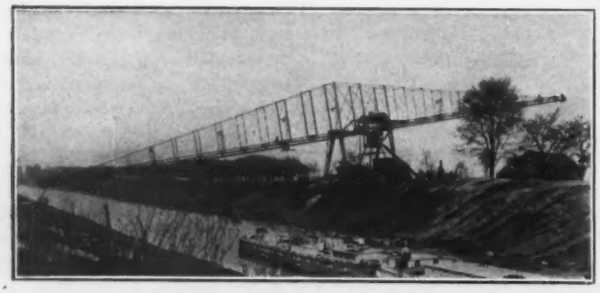


Fig. 3—Cantilever Crane on Barge Canal.

consists of an office building, storehouse, power house, machine and blacksmith shops, an oil house and a number of small structures; a group further removed is the camp and comprises boarding and lodging houses.

The location of the first group of structures was largely determined by the location of the high-tension lines of the volts and the operation of the contractor's step-down station is intrusted to the transmission company. The transformer equipment consists of three 500-kw water-cooled, delta-connected, 60,000-2200-volt, single-phase transformers.

The main equipment in the power house of the contractor consists of a large air-compressor plant producing normally

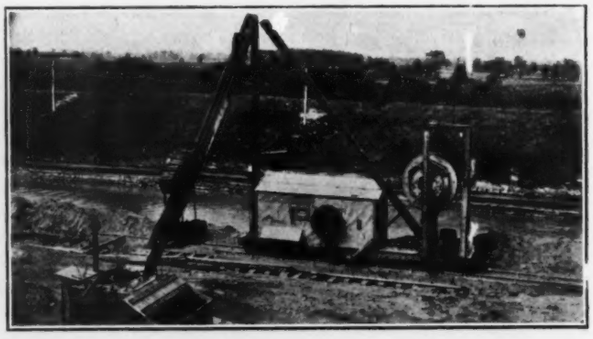


Fig. 4—Portable Transformer House.

8400 cu. ft. of free air per minute at a pressure of 105 lb. per square inch. Each compressor is a two-stage duplex machine driven by an electric motor located between the compressor cylinders. The compressors are three in number and were employed by the same contractor in the underground tunnel work of the Pennsylvania Railroad across New York City a few

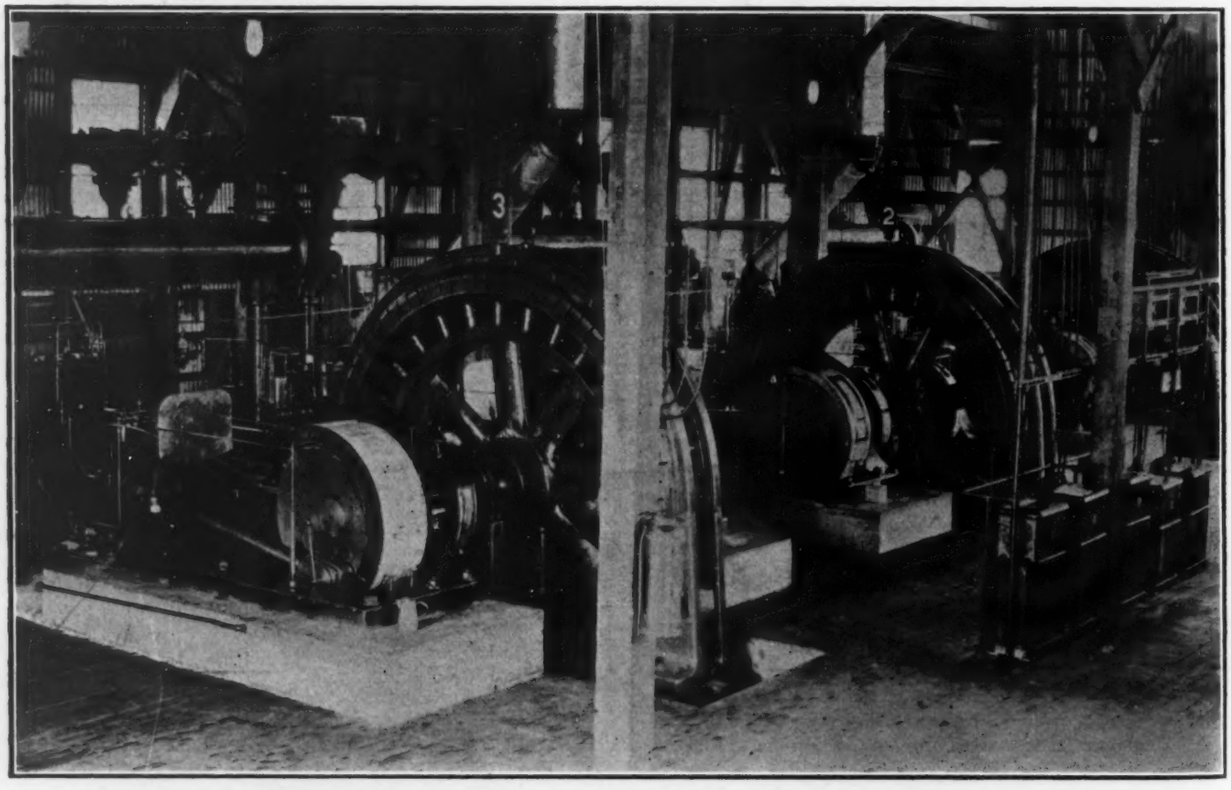


Fig. 5—Motor-Driven Compressor Plant of the United Engineering & Contracting Company at Lockport, N. Y.

Niagara, Lockport & Ontario Power Company, from which the energy is purchased. The switching station of the transmission company is located close by, and here the potential is stepped down from 60,000 volts to 2200 volts, and circuits carrying energy at this potential run to the compressor house of the contractor. The load required an addition to the Niagara, Lockport & Ontario Power Company's switching station at the expense of the contractor, who in addition owns the step-down transformers. The energy is purchased at 60,000

years ago. At that time they were driven by direct-current motors supplied with energy from the mains of the New York Edison Company. At present each of the compressors is driven by a 500-hp, 25-cycle synchronous motor wound for 2200 volts and operating at a speed of 107 r.p.m. Two exciter sets comprising a 75-hp motor and a 50-kw generator are installed, either of which is large enough to supply the excitation of the three motors in question.

From the compressor plant air lines run along the bank of

the canal for supplying air to drills, hoists, an excavator and a number of small pumps. In addition to the air line, a water line and three-phase electric transmission line are carried practically the entire length of the contract. The three-phase line supplies energy for the operation of a cantilever crane, a number of pumps and a tipple near the eastern end of the work. In addition electricity is used for lamp circuits, "G. I." flaming-

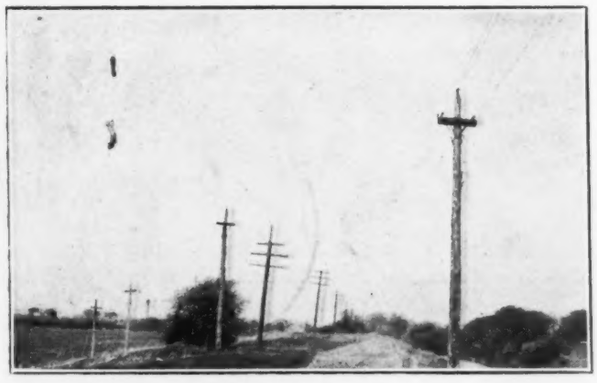


Fig. 6—Contractors' Transmission Line.

arc lamps operating on 25-cycle circuits being employed at night. The electrically driven pumps are of two sizes. Six of them are 6-in. volute pumps with a capacity of 1000 gal. per minute against a 48-ft. head and each is direct-connected to a 25-hp, 440-volt induction motor. Two others are 12-in centrifugal pumps having a capacity of 4000 gal. per minute against a head of 50-ft. and each is driven by a 100-hp induction motor.

For taking out the earth section the contractor installed a large cantilever crane 382.5 ft. long and mounted on a tower with a 35-ft. x 37-ft. base. The cantilever arm overhanging the canal is 192 ft. 9 in. long and that over the spoil bank 152 ft. 1 in. The trolley has a run of 360 ft. It is possible to use this outfit while navigation is in progress. The crane is operated by a 225-hp induction motor geared to two drums, one for hoisting and the other for the trolley traverse ropes. The energy is obtained from the three-phase line on the other bank of the canal and connections are made with this line by conductors suspended across the canal and terminating on the other side in a traveling transformer car. The wires are carried high enough to clear the towpath and barges, and the suspended length allowed is sufficient to permit the transformer car to travel about 100 ft. along the canal. However, since a greater travel than this was desired for the crane without

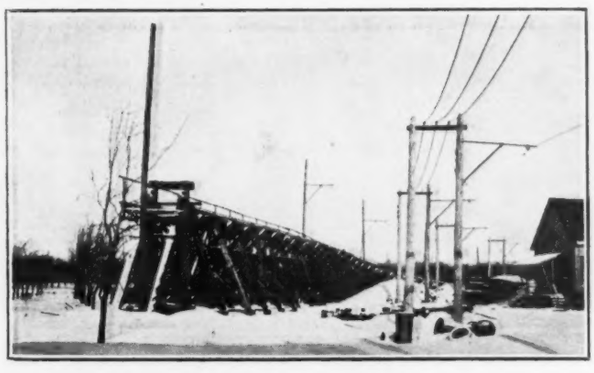


Fig. 7—Contractors' Transmission Line.

changing the connection to the pole line, and since it was necessary for the crane to travel independently of the car, a flexible connection was provided for the two. This scheme was designed by Mr. W. C. Lancaster, assistant manager of the contracting company.

The transformer car is mounted over one pair of the rails on which the crane runs and a stiff-leg extends across to a truck on the other pair of rails. On the transformer car are four 60-kw transformers stepping down the potential from 2200 volts to 440 volts. Three of these are in service and the fourth is provided as a spare. During the summer it is found that the transformers are liable to overheat, and for that reason a 2-hp induction motor is installed to operate a fan for keeping up a good circulation in the transformer house. Each of the three low-tension lines emerging from the transformers is carried

Fig. 8—Electric Pump in Canal Bed.

to a pair of trolley wheels which engage heavy wire forming three separate circles carried on insulators on the outside of a drum. From each of these circular wires a permanent connection is taken off on the inside of the drum and the three connections thus secured are wrapped into a large cable which is wound on a drum adjacent to the three circles of wire. About 100 ft. of this cable are provided and the other end is connected to the operator's cabin on the cantilever.

Provision is made for keeping the cable taut on the reel and for that purpose a wire rope is wound around a small auxiliary drum on the same shaft as the reel and is led to a seven-part tackle, the stationary block of which is at the top of the mast on the transformer-house side of the outfit. The other block is attached to a carriage traveling on a rail on the stiff-leg which reaches across the track from one set of crane rails to the other. This carriage is loaded with 3½ tons of pig iron and its weight serves to prevent undesirable sag between the crane and the transformer car, and to wind up the cable when the distance between the two is decreased. Upon the truck carrying the lower end of the stiff-leg is a tool house in which there are a machinist's bench and a telephone connected with the central power house.

When the car and the crane have gone as far ahead as pos-

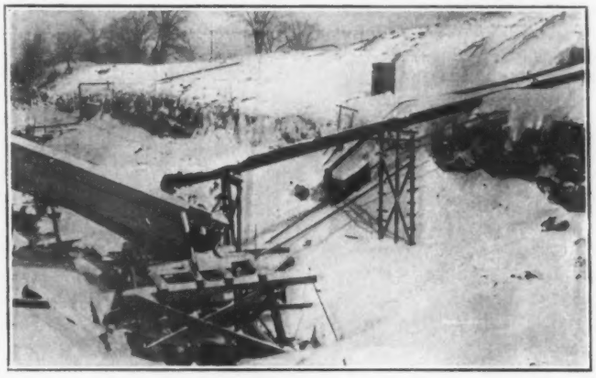


Fig. 9—Electric Pump.

sible it is necessary to disconnect the lines on the towpath side of the canal and to move the connection forward to the next pole. This distance is 125 ft. Long practice has made the operators in charge of the machine very proficient in advancing the line. A test of the time lost in the change was made to determine the efficacy of the arrangement. Over the telephone line terminating in the tool house orders were given to the

power house to shut off the circuit. The three lines were then disconnected, carried forward 125 ft., the terminals hoisted to the next pole and connections restored. From the time the order was given to shut off the circuit until a counter-request was made to turn it on again was eighteen minutes.

The crane travels on four four-wheel trucks, one beneath each leg of the tower. In some cases it has been necessary to do considerable cribbing where hollows had to be crossed. This scheme insures a track with all rails properly spaced and safeguards against the rails spreading. The rails rest on tie-plates and are provided with rail braces, while the stringers are properly spaced and held by short lengths of angles spiked to the ties. About 240 ft. of such track is used, and, depending somewhat on the progress of the work, either one or two 30-ft. sections are moved in a day, requiring the use of a single-drum air-driven hoisting engine, which drags the parts of the track ahead.

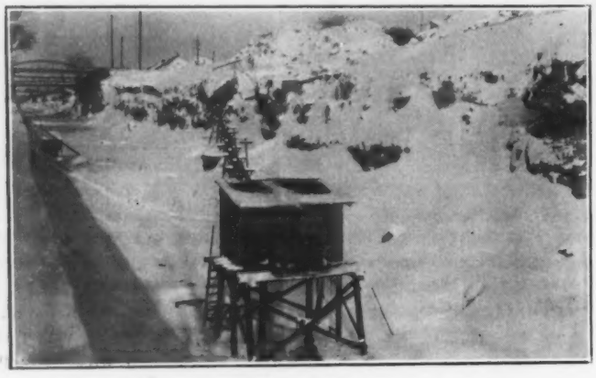


Fig. 10—Electric Pump.

The load-factor of the entire system in winter, when most work is done, averages 75 per cent and during the summer it is about 50 per cent.

ELECTRICAL IRRIGATION ON THE OUTSKIRTS OF CHICAGO.

ON a truck farm within three or four miles of the city limits of Chicago, bordering on a small river, there was installed last year a small electrically driven irrigation plant which is of unusual interest, because it is near a large city and in a region where there is abundant precipitation of moisture, taking the year as a whole. Although the normal rainfall is sufficient for ordinary growing crops, yet there are often prolonged dry periods, and the owner of the plant is convinced that it will pay him to irrigate his land at these times, particularly in forcing "garden truck" for the early market.

A recent central-station extension enabled the enterprising farmer to take advantage of the many conveniences afforded by the use of electrical energy. The owner has had his house, barns and out-buildings completely wired for electricity, so that the premises are now electrically lighted. There is also a 32-cp incandescent lamp in the barnyard. This lamp is controlled from the house, so that when anyone drives into the yard after dark a switch in the house may be turned on and the yard is instantly flooded with light. An electric motor is placed in the basement of the house, and to it is belted a line shaft from which a cream separator, a washing machine, a churn and other small machines are driven.

The present irrigation plant (Fig. 1) consists of a single-stage centrifugal pump belted to a 5-hp. three-phase, 60-cycle, 220-volt General Electric motor. The pump is driven at 740 r.p.m. and delivers 480 gal. of water a minute against a 25-ft. head. To install this outfit a pit or recess was dug in the bank of the river. Over this hole a platform was built upon which the pump is mounted. From the pump a 6-in. intake pipe 8 ft. long drops vertically into the water. This intake is provided with a valve which prevents the water flowing back into the river when the pump is shut down, and thereby the pump remains primed for a considerable length of time and seldom has to be primed by hand when starting. The arrangement of the pumping outfit is shown in Fig. 2.

Fig. 1—Motor-Driven Centrifugal Pump.

A 4-in. discharge pipe is carried from the pump to the top of the river bank and water is discharged into a ditch which conveys it to portions of the farm which it is desired to irrigate. The discharge of the water on the land is illustrated in Fig. 3.

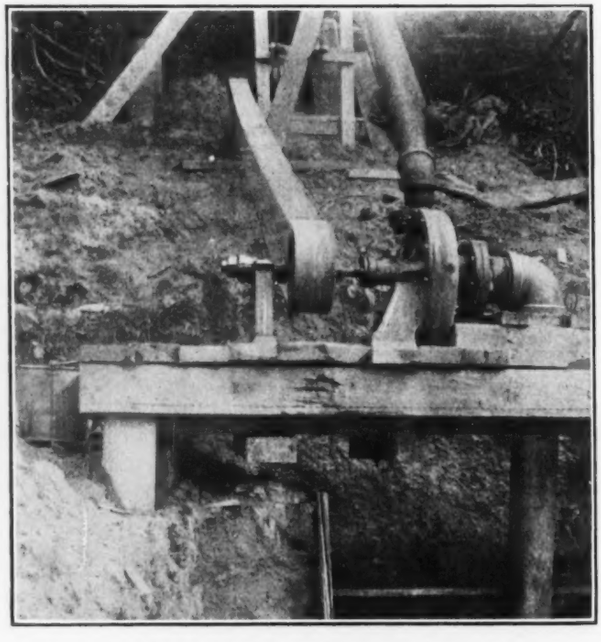


Fig. 2—5-hp Motor Belted to Pump.

The irrigating system was installed late last season and will be extended, probably. So far the water has been used only to irrigate twelve acres of sweet corn, the water being run between the rows in the furrows left by the cultivator.

A test shows that the pump motor requires an input of

4.4 kw, and the meter showing energy used on this service registered 148 kw-hours between July 15 and Aug. 19, 1910, which would indicate that the pump was operated approximately thirty-four hours, or about one hour a day. It is estimated

Fig. 3—Discharge of Pump.

that this expenditure of energy was sufficient to deposit on the land about 980,000 gal. of water. This would be sufficient to cover the field irrigated three times to a depth of 1 in. Apparently the pumping of the water cost about 1.5 cents per 1000 gal.

The pumping installation cost the owner about $200 and he was required to pay $75 toward the cost of the line serving it, which was rather long considering the amount of energy taken by the motor. The motor has been used for cutting feed for cattle during the winter, having been transported to the barn for that purpose, and it will be used at other points about the farm when not needed to drive the pump.

The owner of this pumping installation expects to irrigate about 25 acres of land with it this year, and he is also considering the installation of a similar or smaller plant to irrigate his land on the other side of the river.

ELECTRIC DRIVE IN A CHICAGO LIMESTONE QUARRY.

ONE of the most interesting of the recent industrial applications of electricity in Chicago is the new electrically operated plant of the Chicago Union Lime Works Company at Nineteenth and Lincoln Streets. It is of interest, not only because it is an excellent example of the usefulness of electric drive, supplanting an old steam plant, but because of the unusual character of the stone quarry itself.

Few people realize that there are several stone quarries in operation within the city limits of Chicago. Perhaps the one of greatest interest is that of the company referred to in the present article. It is within twenty minutes' ride of the Union Loop district by elevated railway, and yet here, almost in the heart of a large city, is a great hole in the earth nearly as large as a city block and almost 300 ft. deep. This unusual condition is explained by the fact that the quarry was established in 1859 by Mr. T. W. Phinney, the president of the company, who is now advanced in years and resides in Newport, R. I. At the time it was established this quarry was well out in the country, but the city has gradually grown around it. A high board fence surrounds the pit on all sides, so that the ordinary passer-by is not aware of its existence.

The quarry has been gradually excavated straight down in solid limestone rock, the sides of the pit going down sheer to a depth of nearly 300 ft. The rock is blasted out at the bottom and hoisted to the works at the top, where a part of it is converted into crushed stone and the remainder burned in lime-kilns.

Fig. 1—General View of the Limestone Quarry.

For many years the plant was operated by steam, but as nowadays nearly all modern stone plants use electric drive, it was determined last year to erect an entirely new crushing plant and at the same time substitute electricity for steam. This change in motive power is an economical one, particularly as the use of steam involves a live-steam pipe line about 400 ft. long to operate the pump at the bottom of the quarry with the consequent losses by condensation. All the operations of

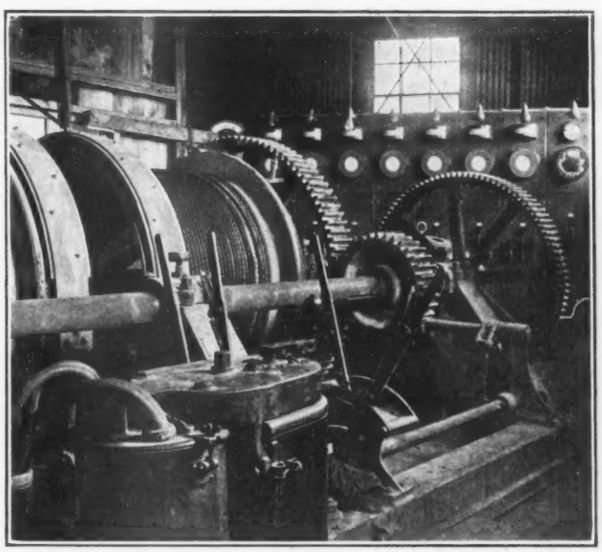


Fig. 2—Electric Hoist and Switchboard.

the plant are now conducted by means of electrical energy, and the proprietors are well satisfied with the change. Fig. 1 gives a general view of a portion of the quarry, showing the abandoned plant at the right and the new electrically operated plant, with its vertical hoist, at the left of the old plant. The long stairway for workmen, on a rock incline, is also shown.

Electricity is purchased from the Cosmopolitan Electric Company and comes to the plant over an overhead four-wire

circuit carrying 2300/4000-volt, three-phase, 60-cycle alternating current. The incoming wires are taken through lead-covered cables into a fireproof transformer-room in the steel-and-concrete crusher house. This transformer-room has floor dimensions of 8 ft. x 12 ft., and its walls consist of slabs of concrete which were poured on the spot. It contains six General Electric air-cooled transformers for the motor circuits and also one 10-kw transformer for the lighting circuits. The

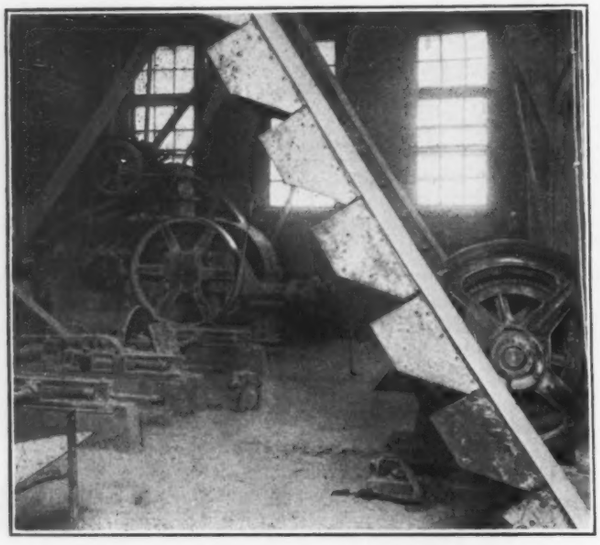


Fig. 3—7.5-hp Motor Driving Crushers and Rolls.

secondary circuits from the motor transformers are operated at 440 volts, and the lighting circuits at 110 volts. All wiring throughout the plant is in conduit.

There are six motors in the plant, all made by the Allis-Chalmers Company. The largest one is rated at 125 hp and is directly geared to the winding drum of the balanced hoist which lifts the cars of limestone rock from the bottom of the quarry to the unloading platform of the hoist in the crusher house, this being a straight lift of 290 ft. The rotor of the hoisting motor is phase-wound, and the controller for operating the motor is of the Cutler-Hammer drum type. At the top of the hoist the cars are run onto the tracks of a tramway and either pushed by hand to the edge of a No. 7½ crusher, where their contents are discharged, or else turned by means of a turntable and run along a track leading to the tops of the kilns.

The controlling switchboard for all motors and lamps is located in the room containing the hoisting machinery, and is shown in Fig. 2. It is an eight-panel slate board consisting of one service panel, six motor panels and one lighting panel. The last named controls the ci rcuits supplying one flaming-arc lamp and 125 incandescent lamps used about the premises. Each of the motor and lighting panels is equipped with the necessary switches and also with a Westinghouse watt-hour meter and a Wagner ammeter. There is also a bracket-mounted Wagner voltmeter and, on the service panel, a total watt-hour meter made by the Fort Wayne Electric Works. Behind the board is placed a printing attachment made by the Chicago Electric Meter Company to show the maximum-demand registration.

A 75-hp motor is belted to shafting which drives two continuous-bucket elevators, two revolving screens and two shaking screens. The No. 7½ crusher previously referred to is directly belted to a 75-hp motor. Another motor of the same size drives shafting to which are belted two No. 3 crushers and two sets of crushing rolls. This is shown in Fig. 3. An air compressor made by the Chicago Pneumatic Tool Company is directly belted to a 75-hp motor, the motor, compressor and tank being housed together on the ground level. Two lines of piping for compressed air lead from the tank to which the air compressor is attached. One of these runs down into the quarry and serves to operate the pneumatic drills used to make the holes in the rock for blasting. The other air line is subdivided and runs to convenient points in the crusher house, where compressed air is used for various purposes, such as blowing out the motors, etc.

At the bottom of the quarry, in its own housing, is a 60-hp motor which drives a three-stage centrifugal pump of the Escher-Wyss type. This pump serves to free the bottom of the quarry both from surface water and from the water of springs which are encountered in the rock. It lifts the water a distance of 260 ft. to the surface of the ground, where it is discharged into a sewer. The capacity of this pump is 400 gal. a minute, and it is direct-connected to its motor. All motors are of the 440-volt, 60-cycle, three-phase, alternating-current type.

The products of the Chicago Union Lime Works Company are lime and crushed stone. To one unaccustomed to lime burning it is interesting to note that the fuel used in the kilns consists of shavings and manure, which is said to give the best result. Mr. Julian J. Pleas is vice-president of the company and Mr. T. P. Henderson is secretary and treasurer. The consulting engineer for the new crusher plant, including electrical equipment, was the J. C. Buckbee Company, Mr. James J. Bassett having immediate charge of the installation. The Lounsbery Brothers Company was the electrical contractor.

ELECTRICITY FOR FARMERS IN KNOX AND PEORIA COUNTIES, ILL.

ONE of the first among the small central-station companies to make a practice of carrying its electric service wires to the doors of neighboring farmers is the Elmwood Electric Light Company, which from its steam-driven generating station at Elmwood, Ill., furnishes electricity for lighting and motors to about fifty farms scattered along the lines of its transmission system in Knox and Peoria Counties within a radius of twelve miles.

The extent of the present distribution lines is shown by the accompanying map of the system, on which the locations of the farm customers have been indicated by black circles. The principal business of the Elmwood company, of course, is the supply of energy to consumers in the several small towns reached by its lines, as shown. In Elmwood, where the power

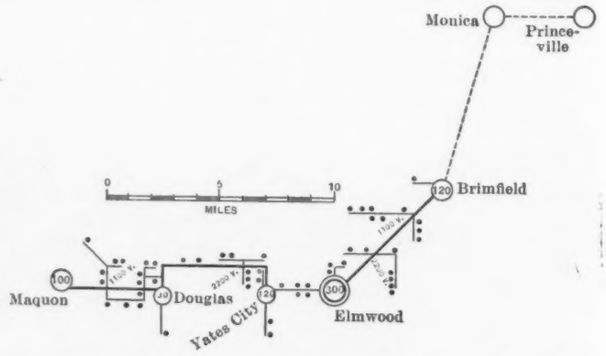


Fig. 1—Transmission System and Farm Customers of Elmwood (Ill.) Electric Light Company.

plant and office of the company are located, it has 300 customers; in Yates City, 120; in Douglass, 30; in Maquon, 100, and in Brimfield, 120. As indicated, the company is extending its lines to Monica and Princeville, where additional loads will be taken on. The region penetrated by this new 13,200-volt transmission line is of unusual agricultural wealth and a number of farmers' installations will be added to the Elmwood system when this extension is completed.

The generating equipment at Elmwood comprises a 325-hp Chalmers-Corliss engine driving by belts an "80-light" Wood arc machine and one 100-kw and one 138-kw Fort Wayne 1100-volt, 60-cycle, single-phase alternator, besides a 125-hp Cooper-Corliss engine driving an 85-kw Fort Wayne 1100-volt, 60-cycle, three-phase alternator. Elmwood and the system east are served from one phase, the western extension by a second phase, while the third phase will remain idle until the new

Fig. 2—Step-Down Transformer Supplying Eight Farms Through Six 1-kw Transformers and Three Miles of Land.

Princeville line is completed. The three-mile line from Elmwood to Yates City operates at the generator e.m.f. of 1100 volts, while the lines beyond, to Douglass and Maquon, have their pressure stepped up to 6600 volts through a 30-kw transformer at Yates City. The eastern system, from Elmwood to Princeville, will utilize 13,200-volt transmission, raising the pressure of the present Brimfield line, which operates at 2000 volts.

From the main transmission lines step-down transformers of from 5 kw to 10 kw rating reduce the line potential to the distributing pressure, 2200 volts or 1100 volts. This single-phase, 60-cycle energy at this voltage is then brought directly to the farmer's yard, where a 1-kw pole-type transformer again reduces it to the house pressure, 104 volts. In some instances two farms are served from the same 1-kw transformer where this can be conveniently done. Two farms on the line between Yates City and Douglass are served through 1-kw step-down transformers directly from the 6600-volt transmission wires. Several of the 1100-volt and 2200-volt secondary distributing lines are three miles or more in length, serving half a dozen farmers along the route.

The Elmwood company offers to extend its lines to any farmer desiring service within three-quarters of a mile of its existing lines provided the farmer pays $1 per pole (thirty-five to the mile) and hauls and sets the poles. Part of this secondary distributing system uses iron wire, No. 8 extra BB being found to combine the required mechanical strength and conductivity necessary for these scattered services. The poles are set at intervals of from 140 ft. to 170 ft. Such pole-line secondaries cost the company about $100 a mile, and a farmer's installation, including meter, transformer and labor of installation, costs about $50 complete. All farmers' services are metered, both meters and transformers being furnished by the company. No contract or agreement to use a required amount of electrical service is demanded of a prospective customer in order to get the company to extend its lines to his house, except the payment for poles and hauling, as above mentioned.

The rate for electrical energy to all consumers on the Elmwood system, whether in the towns or on farms, is 10 cents per kw-hour regardless of the quantity consumed. The urban customers pay a monthly minimum of $1 for each service, while the farm minimum is $2 a month. Besides the extra cost of reaching farm customers, including line and twenty-four-hour transformer losses, which are naturally disproportionately high for isolated services, the extra minimum bill imposed upon the farmer is justified by the greater number of lamps he usually has installed and his consequently greater demand during the lighting peak. The average farmhouse on the Elmwood system has from twenty to thirty lamps, including porch lamps and yard lamps, and generally several lamps in the stable.

The farm peak lighting load comes on earlier than the usual town load. On the country lines another distinct lighting peak comes shortly after 3 a. m., when the farmers begin to rise early to commence the day's work, eating breakfast and doing the morning chores by electric light. Unusual lighting demands were also noticed by the station attendant during last November, when the farm employees were working early and late picking corn.

Besides the lighting service every farm on the Elmwood system has one or more electric flatirons, of which the housewives make good use. A number of small motors are employed to operate churns, pumps, washing machines, fans, cream separators, feed grinders, etc. Except flatirons electric heating and cooking appliances do not seem to take well with farm users in the experience of the local company. Farm appetites usually require appeasing on a larger scale than electric cooking appliances are capable of operating economically.

All farm customers are equipped with meters, which are read at two-month intervals by a representative of the company who uses an automobile for getting around. At these visits the inspector reads the meter, estimates the consumption and then figures the bill for the preceding two-month period, collecting the amount before he leaves the house. Some member of the farmer's family is usually always at home, and as the electrical man's visit is expected, a blank signed check or money to cover the amount is waiting when he arrives. A few lamps, sockets

Fig. 3—Typical Farmer's Installation on Elmwood System.

and small repair parts are also taken along in the automobile or wagon, and burned-out lamps or broken fittings are replaced. Lamps and parts are sold at nearly cost. Emergency repair service, such as the replacement of blown link fuses, etc., is rendered without charge. A telephone call to the main office at Elmwood brings the repair man in haste. The trouble call cost the consumer nothing. He is, however, equipped with extra Edison-base fuse-plugs so that these can be replaced

without summoning the repair man. Country houses are wired at cost by the electric light company. Such installations average $1 a lamp, not including ornate fixtures which a customer may desire.

The farmer's average monthly electric bill on the Elmwood system is from $2.50 to $3. In the summer time the $2 minimum is usually registered by the housewives' ironing consumption. Winter bills rise proportionately higher. Farm customers are satisfactory and thoroughly reliable. They pay promptly on demand and seem pleased with the quality of the service rendered them. Most of the customers of the Elmwood system own from 100 acres to 600 acres of fine farming land, which is assurance of their substantial financial rating. Besides demanding more lamps about the place, the average farm owner uses more electricity each month than the town dwellers in similar circumstances. No effort has been made by the Elmwood company to obtain its present farm customers, for the demand for its service has always exceeded the extent of its lines. As each farmer heard of his neighbor's improved lighting conveniences he also applied for service, and many importunities have been received from residents at uneconomical distances from the lighting lines. Once the service is installed and the farmer has invested labor and expense in his pole line he becomes a satisfied consumer, and no other form of contract or agreement is required to hold him as an electrical customer. Mr. E. L. Brown, who is president and general manager of the Elmwood Electric Light Company, expresses himself as well pleased with the results of his farmer-line extensions and contemplates large-scale increases to this business when additional lines now under construction are completed. His son, Mr. E. O. Brown, is district manager of the company.

COST OF GENERATING ELECTRICAL ENERGY IN STEAM-DRIVEN CENTRAL STATIONS OF SMALL AND MEDIUM SIZE.

By E. F. Tweedy.

In view of the very large number of central stations of small and medium size scattered throughout this country some figures showing the actual cost of producing a kw-hour in a number of stations which come under such a classification should be of interest. The figures herein presented are believed to be authentic, inasmuch as they have been obtained from reliable sources which give not only the cost of operation in detail, but considerable information regarding the type of equipment as well. While the stations which have been selected have a yearly output, as measured at the switchboard, of less than 9,000,000 kw-hours, it is not the writer's intention to use this figure as the dividing line between central stations of medium and of large size, for if it were so used it would be difficult properly to classify the few really large central stations which have yearly outputs running into the hundreds of millions of kw-hours.

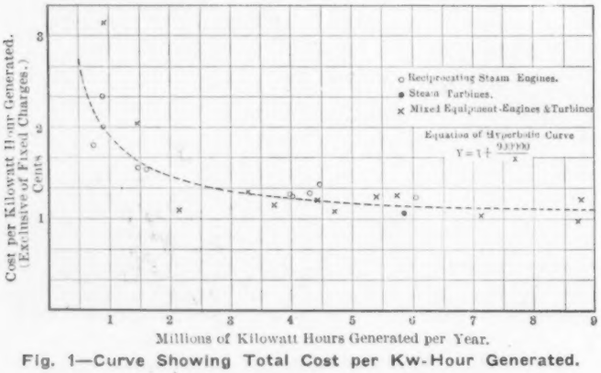

Cost per Kilowatt Hour Generated. (Exclusive of Fixed Charges.) Cents
Millions of Kilowatt Hours Generated per Year.
○ Reciprocating Steam Engines.
● Steam Turbines.
× Mixed Equipment-Engines & Turbines
Equation of Hyperbolic Curve
$Y = 1 + \frac{900000}{x}$

Fig. 1—Curve Showing Total Cost per Kw-Hour Generated.

Fig. 1 shows the total cost per kw-hour generated—including such items as fuel, labor, repairs, supplies, etc.—plotted against the total number of kw-hours generated per year, for some twenty-odd central stations. These stations not only vary considerably in size, but also as regards the nature of their equipment. While all of these plants are operated condensing, some of them—particularly the smaller ones—are still using belt-driven generators of comparatively small capacity.

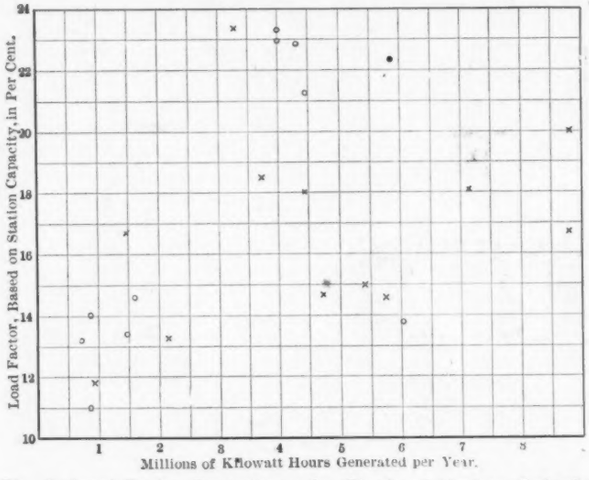


Fig. 2—Load-Factor Percentages for Plants of Various Outputs.

Bituminous coal, ranging in price from $2.75 to $5 per gross ton, is used almost exclusively, although in a few of the plants a certain amount of coke, coke-breeze or screenings is used. With the exception of one plant, the boilers are all hand-fired.

It will be observed that those plants in which turbine units have been installed show no lower cost of operation than the reciprocating-engine plants of similar output, which is not altogether surprising for plants of the capacities shown. The lessened cost per kw-hour with increased yearly outputs is of considerable interest, and it is evident that 1 cent per kw-hour at the busbars is about the lowest unit cost which may reasonably be expected—with present types of steam-driven equipment—until a yearly output in excess of some 10,000,000 kw-hours is reached. Fig. 1 shows that the variation in cost per kw-hour with the output is substantially hyperbolic in character and may be approximately expressed by the equation $Y = 1 + (900{,}000 \div X)$. This hyperbola is shown by a dotted line, and it is evidently asymptotic with respect to an X axis drawn through 1 cent per kw-hour. Of course, this relation does not hold good for greater yearly outputs than are shown in Fig. 1, for the cost per kw-hour soon falls below the 1-cent line as the yearly output is further increased, and it becomes ½ cent or less in stations of very large output.

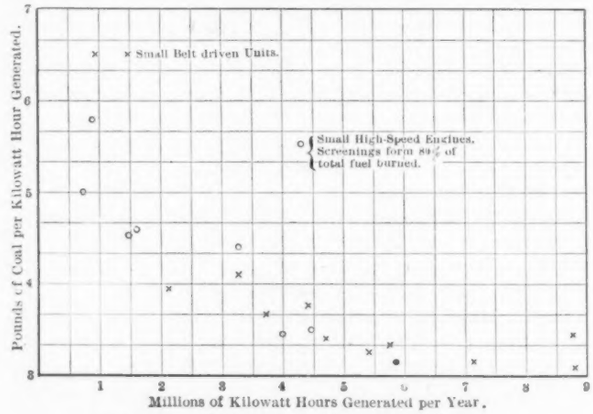

Pounds of Coal per Kilowatt Hour Generated.
Millions of Kilowatt Hours Generated per Year.
× Small Belt driven Units.
○ Small High-Speed Engines. Screenings form 80% of total fuel burned.

Fig. 3—Coal Consumed per Kw-Hour.

While the load factor should, and undoubtedly does, have a considerable influence upon the cost of producing a kw-hour, the variation in unit cost does not follow the variation in load

factor with any degree of closeness in the stations herein cited. The load factor increases in a general way with the output in kw-hours or with the size of the central station, due, as a rule, to an increase in the connected motor load, but Fig. 2 shows that such increase is not at all uniform for the plants herein considered. The load-factor percentages shown in Fig. 2 are based upon the rated capacities of the stations, as the maximum hourly outputs were not available in all cases.

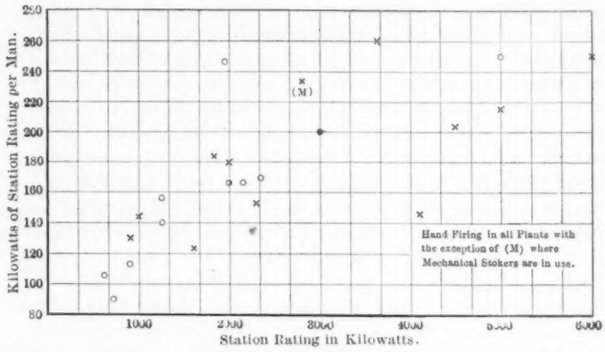

Kilowatts of Station Rating per Man.
Station Rating in Kilowatts.
(M)
Hand Firing in all Plants with the exception of (M) where Mechanical Stokers are in use.

Fig. 4—Generator Rating per Man Employed, for Various-Sized Stations.

When based upon the maximum outputs the yearly load factors would probably average some 10 per cent greater than the figures given. The highest load factor for any of these stations, based upon rated capacity, is about 23 per cent and the lowest 11 per cent, while the average is approximately 17 per cent.

The reduction in the cost per kw-hour as the yearly output in kw-hours increases is, of course, due to the smaller coal consumption per kw-hour which, as a rule, obtains in the larger stations and to the lower labor costs per unit generated. Fig. 3 shows the consumption of fuel per kw-hour in these same plants. While the consumption of fuel per unit generated very evidently varies inversely as the output, this variation is not altogether uniform, due primarily to differences in the quality of the fuel which is burned and to the different types of equipment which are in use. It is evident that 3 lb. of coal per kw-hour may be considered to be a minimum figure for steam plants with an annual output not exceeding some 10,000,000 kw-hours. In very large stations, of course, this figure may become 2 lb., or even less.

Fig. 4 shows the number of kilowatts of rated station capacity per man employed, power-plant labor alone being consid-

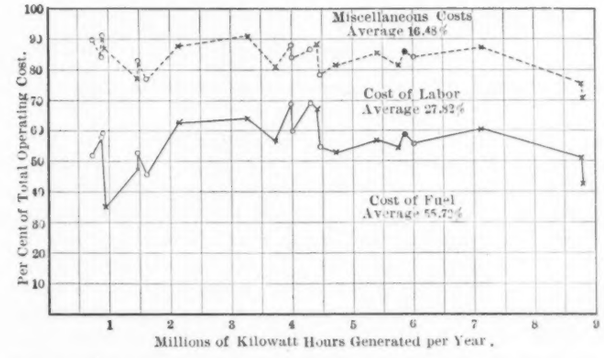

Miscellaneous Costs Average 16.48%
Cost of Labor Average 27.82%
Cost of Fuel Average 55.72%
Per Cent of Total Operating Cost.
Millions of Kilowatt Hours Generated per Year.

Fig. 5—Percentages of Total Operating Costs Due to Fuel and Labor Expense.

ered. The abscissas represent the rated capacities in kilowatts of the same stations whose outputs are shown upon the other charts. It is interesting to observe how the number of kilowatts per man increases as the stations become larger in size. As a result of this the labor cost per unit generated becomes progressively less as the capacities—and outputs—increase. The lowest cost of labor per kw-hour for the plants herein considered is slightly below ¼ cent and the highest cost is slightly above 1½ cent; the average labor cost per kw-hour generated for all of the plants is 0.43 of a cent.

Fig. 5 shows the percentage relations of the cost of fuel and of labor to the total operating cost. It is evident that these relations are in no way affected by the annual output. The average percentage which the cost of fuel bears to the total operating cost is found to be 55.7, while the average percentage for labor is 27.8. The average of these two items combined, is, therefore, slightly over 83 per cent, which leaves an average of a little less than 17 per cent of the total operating cost to cover such items as repairs, supplies, etc. The average ratio which the cost of fuel bears to the cost of labor is approximately two to one.

In closing, the writer would venture the opinion that central-station managers, both individually and collectively, would greatly profit from a more free interchange of data bearing upon the cost of operating the properties which are in their charge. This could readily be accomplished through the channel which is afforded by the technical press, and figures of this kind—if confined to a dollars-and-cents basis and properly interpreted according to the conditions under which electrical energy is being generated—would be of great interest and value. The generation and sale of electrical energy is not like the ordinary manufacturing business, where competition generally makes it necessary carefully to conceal the cost of production. Central stations—except possibly in a few rare instances—are in no sense competitors and the interest of one is the interest of all when it comes to the matter of producing a unit of electrical energy at the lowest possible cost.

DESIGN AND OPERATION OF WATER RHEOSTATS

By Francis H. Davies.

In designing a water rheostat for dissipating any considerable amount of electrical energy a large number of difficulties are apt to arise. Outwardly it would appear a simple matter to provide a tank or series of tubs and the requisite electrodes, and by manipulation to secure the desired load, but in practice it is found that for tests upon all but the smallest plant something far more reliable and easy to operate is required. There is room in most central stations and testing departments of any importance for a well-designed and permanent water rheostat, and many are so equipped, but there is very little information available as to their construction and the designer has generally to start from the beginning each time and arrive at a satisfactory solution by a process of trial and error. Anything approaching to standardization in design is, of course, impossible owing to the widely different conditions which obtain, but there are certain natural laws which enter into every case alike, and there are features of mechanical design which, with suitable modifications, may be advantageously incorporated in any type of water rheostat.

The resistance of water decreases materially with rise in temperature, and it is not possible to give any figures of practical value in this respect, as the quality of water and to some extent the conditions make an appreciable difference. Fig. 1 gives the results of a test carried out by the writer on what may be taken as good average water from the public service. These results are to some extent useful, as they indicate what may be expected under average conditions. The current was direct at a pressure of 500 volts and the test lasted two and one-half hours, during which time no additional water was added for cooling purposes. The chief point of interest lies in the relation between the two curves. The manner in which the current rises shows that the resistance of the water decreases in a greater ratio than the rise in temperature, and there is little doubt that this may be at least partly explained by the presence in the water of iron from the electrodes, which effect would naturally become more pronounced as the solution became stronger. Proof of this lies in the fact that with alternating current the decrease in resistance is by no means so marked.

In the matter of specific resistance water is known to vary

between very wide limits, and it is, therefore, necessary in designing a water rheostat to take fully into account the class of water which will be employed. Owing to its comparative purity it is almost always preferable to utilize the town supply, but it is necessary to bear in mind that all so-called pure waters are by no means alike in specific resistance. They may, indeed, vary considerably in different districts. Published figures from authoritative sources show that the specific resistance of the water of one district may be as much as seven times that of another. It is, however, when canal or river water is used that the greatest difficulties are experienced, as the specific resistance of such is by no means as constant as that of the average town supply. It will be found, as a rule, to vary considerably with the time of year, being at its lowest when the water is most impure. For instance, a canal which runs through an urban district will contain a quantity of decaying matter, and in summer the resistance of its water may be considerably lower than in winter. Some testing operations carried out by the writer in which two electrodes were suspended in a canal showed that to secure an equal load at the same voltage the electrodes during the summer had to be spaced six times as far apart as in the winter. An additional reason in favor of employing pure water is that the hot overflow from

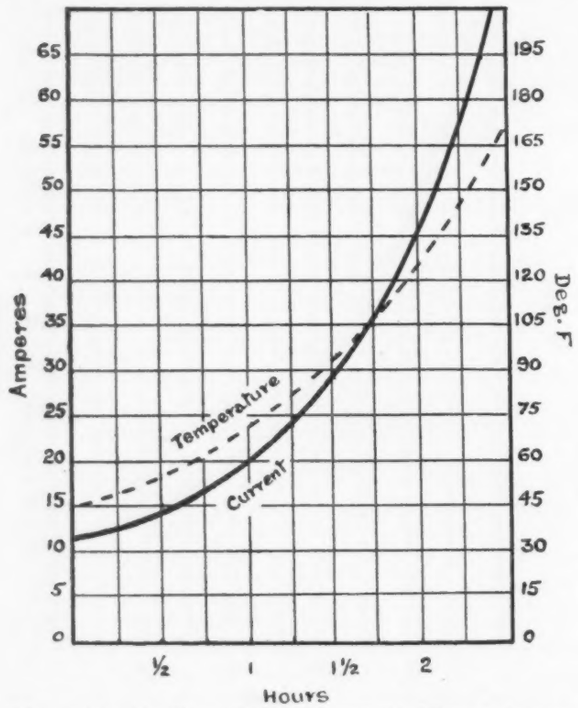


Fig. 1—The Variation of Current with the Temperature of Water.

the testing tank may with advantage be used as boiler feed, and some installations are specially designed to this end, as, for instance, that illustrated in Fig. 3.

It is a common practice where the resistance of a testing tank is found to be too high to add a percentage of sulphuric acid, soda or salt to the water. This may be necessary at times, but whenever possible it should be avoided, particularly at the commencement of a test. Unless care is taken and the effect of increased temperature fully anticipated there is always a chance that the apparatus may be rendered temporarily useless by more rapid fall in resistance than was expected. In any case salt or soda should be used in preference to acid, as the corrosion of the tank and electrodes will be less. An electrolyte which has been recommended, at any rate, for small resistances, is a 2 per cent solution of aluminum sulphate, the electrodes being of lead. It is found that little if any fumes or sediment is formed, and unlike most chemical electrolytes it is clean. The resistance varies inversely with the strength of the solution, but not proportionately.

Given the right conditions, a pond or any sheet of water may be used as an artificial load and many suitable arrangements for the electrodes will suggest themselves. It is, however, seldom that matters can be ordered in that way, and, as a general rule, a specially designed tank is necessary. Iron finds the greatest favor, but wood, brick and earthenware have all been used and their individual qualities are worth investigating before finally deciding.

Fig. 2 is a diagram of an iron testing tank installed in a large generating station, partly under the supervision of the writer. It was designed to handle both direct current at 600 volts and single-phase current at 2000 volts, and at all loads up to its full capacity of 1000 kw was very satisfactory. The outer tank is comparatively heavy, being built of cast-iron plates with rust joints. It is fitted with an inlet at the bottom and an outlet at the top for the cooling water, which is taken from the station circulating-water main and discharged into an adjacent canal. The inner tank is of stout sheet iron and bottomless, and the beams from which it is suspended are in turn hung from a steel rope which is broken in several places with insulators. The rope runs over a pulley block, through a counterweight to balance the tank and down to a

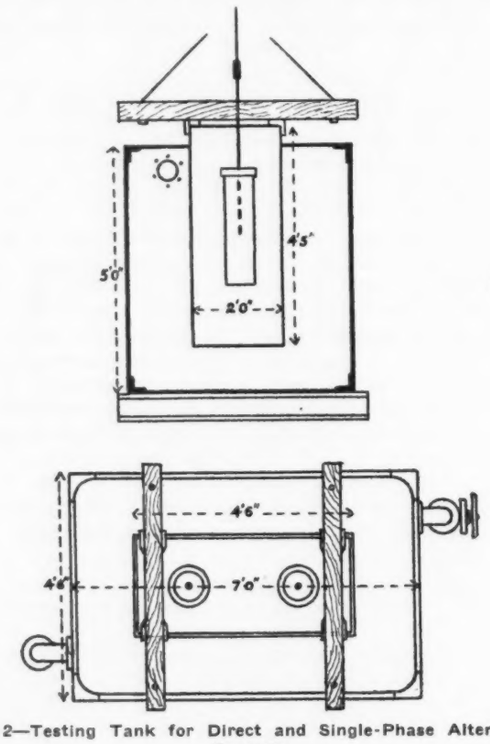


Fig. 2—Testing Tank for Direct and Single-Phase Alternating Current.

small winch, by which means the immersion of the inner tank is readily adjusted with delicacy. In addition to providing for the suspension, the wooden beams prevent any risk of a short-circuit should the steel wires break. No weight is carried by the connecting cable, which is of a heavy flexible type attached to one end of the tank. This arrangement is the one used for working with direct current at 600 volts, the positive pole being connected to the inner tank and the negative to the outer, which is grounded. When it is desired to operate with 2000 volts alternating current one or both of the rod electrodes are used. These are of ¾-in. iron suspended in much the same manner as the tank, and, as will be seen from the top sectional view, Fig. 2, when in the water they are each surrounded by an earthenware drain pipe, the top of which is slightly below the level of the water. The result of this arrangement is that the circulation is greatly improved and the contents of the tank are thereby kept at a fairly uniform temperature. The fact that there are two rods and two tanks allows of great variety in the electrical connections, and widely

varying needs may be met by means of different combinations of the electrodes.

Fig. 3 shows in diagram form the main principles of a testing tank designed to absorb up to 2000 kw of three-phase power at 7000 volts. It is of special interest, as besides being very successful it is arranged to operate in connection with the boiler feed-water system, as mentioned above. The tank is built of 5/32-in. galvanized-iron plate and is 6 ft. in diameter and 4 ft. 3 in. deep. It is situated, as shown, over the feed-water tank and one of the supply pipes from the main is taken to it through the valve *B*. Water passes into the testing tank through the ¾-in. holes in the bottom of the 4-in. standpipe *S*, and it should be noted that the aggregate area of these holes is greater than that of the pipe. A portion of the inlet water flows up to the less number of holes at the top of the pipe and, emerging at the surface of the water, materially checks evaporation. The hot overflow from the testing tank passes down the two pipes at the sides and into the boiler-feed tank. At the top of the pipe *S* is a triangular plate which carries three neutral electrodes *N*, and above this, attached to the small vertical pipe, is a frame carrying the three main electrodes *E*, which are spaced at angles of 120 deg. and are 7 in. distant from the vertical plates. The pipe to which the frame is attached runs outside the smaller one, which acts as a guide, and there is also a vertical rod attached to the electrode frame, which, passing through a hole in the triangular plate, prevents lateral movement. The frame carrying the plates is raised and lowered by a small motor equipped with a winding drum and blocks and tackle. This motor is controlled from the switchroom, which is a great convenience to those carrying out the test.

Wooden tanks are the cheapest to build, and if properly designed have been found very satisfactory. For any given load they are smaller than metal tanks, as the conductivity of the latter renders it necessary to allow for a good space between the electrodes and the sides and bottom of the tank. Difficulty is sometimes experienced with leakage at the joints and with ignition of the wood, but both these troubles seem rather to arise from faulty construction and handling than from any inherent defect in wooden tanks.

Fig. 4 illustrates a good design which has been used by a prominent firm of engine builders for years and was brought to public notice in a paper read by Messrs. Morcom and Morris before the Institution of Electrical Engineers, Great Britain, in March, 1908. It is constructed of two layers of ½-in. spruce, tongued and grooved, and all the joints are tarred and calked. The boards are fixed together by screws in such a manner that there is at least a distance of ¾ in. of wood between any part of the screw and the water, and the whole tank is thoroughly tarred when completed. The cooling water is introduced by a canvas hose which enters at the outlet end of the tank and lies along the bottom as far as the other extremity. The outlet consists of a sectional weir, and the water after passing over this flows away through a hole in the bottom of the tank. Iron electrodes are fixed to and thoroughly insulated from stout wooden bars which rest across the sides of the tank and may be readily moved along its length when it is desired to adjust the load. Prominent features of this tank are its length and shallowness, both of which are desirable in the interests of cheapness and a wide range of working. The design is unquestionably good, but such extreme shallowness is only possible when the tank is constructed of insulating material. In the size illustrated the capacity should be about 300 kw to 400 kw, and to absorb greater outputs it would only be necessary to connect other tanks of the same description in parallel.

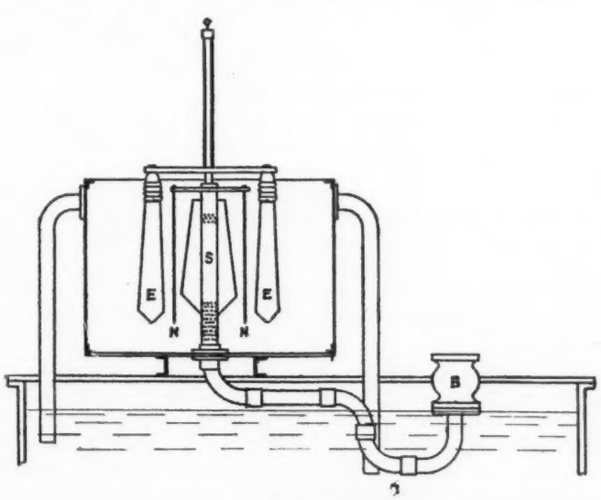


Fig. 3—Testing Tank for Three-Phase Alternating Current, Showing Arrangement for Delivering Hot Overflow to Feed Tank

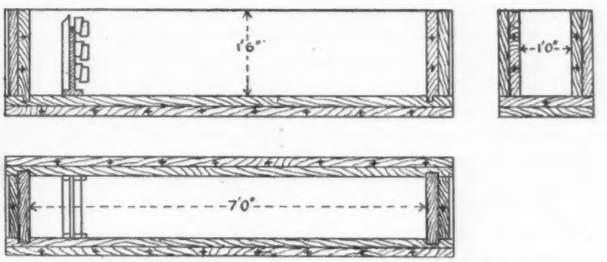


Fig. 4—Method of Constructing Wooden Testing Tank.

Examples of brick or earthenware tanks are rare, but particulars have been published of one of the former class which is employed at a school of technology to absorb some 20 kw at 500 volts. Its internal dimensions are 6 ft. 9 in. x 2 ft. 6 in. x 2 ft., and it is built of glazed blue bricks set in cement to a thickness of 9½ in. A ½-in. layer of mastic asphalt is provided in the walls in order to make them thoroughly watertight. At one end of the tank there are four fixed plates with an area of 1 sq. ft. each. They are spaced at a distance of 7½ in. and their length is parallel to that of the tank. The other electrode consists of three similar but movable plates. V-shaped at the bottom and suspended from a carriage, the wheels of which run on rails parallel with the tank. At the one extreme the movable plates fit between the fixed ones and are fully immersed, but as the other extreme is approached the plates rise partly out of the water, owing to the track being fixed at an angle. This latter is an interesting feature which might be employed with no little advantage in many instances.

Electrode area is an important consideration, and it is best to err upon the safe side. The generally accepted figure for current density is from 0.5 amp to 1 amp per square inch, and if the latter figure be exceeded not only will wasting be rapid, but trouble will be experienced with unsteadiness of the load. This latter is due to the formation of steam and bubbles on the plates, which, changing in quantity and location, vary the area of electrode exposed to the water. An ample supply of cooling water will mitigate this, and it has been determined experimentally that to keep the rise of temperature within desirable limits, that is to say, about 70 deg. Fahr., 5 gal. of cooling water are required per kw-hour.

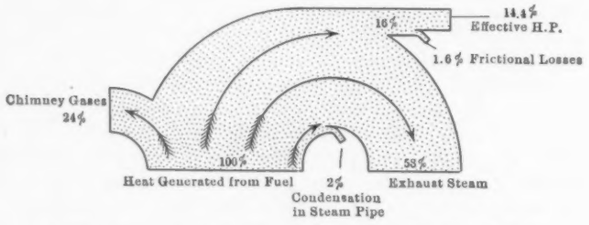
THE INFLUENCE OF FEED WATER ON ECONOMICAL STEAM GENERATION.

By John B. C. Kershaw.

THE purity and temperature of the feed water are of great importance in their bearing upon economical steam generation, and in many cases considerable saving could be effected by greater attention to the boiler feed. The advantages to be gained by using water free from gaseous

and other impurities, at a temperature approximating that of the water already in the boiler, are now generally recognized and the problem for most engineers in charge of steam boilers is how to obtain the maximum of purification and temperature at a minimum of cost. In some cases it will be found cheaper to make use of the town supply, when this is a fairly soft surface water, than to erect and run a softening installation. With regard to this question of softening each case can be decided only after studying all the local conditions and the probable cost for labor, repairs and chemicals if softening plant be erected. It is unwise to assume without investigation (as one finds is often done, especially in small plants) that a dirty, impure water which costs nothing is going to prove the cheapest source of supply. The operating costs of softening plants increase with the amount of calcium and magnesium salts in the water to be purified, and the writer has known a case in which the purification plant has been shut down owing to the amount of soda-ash required for purification.

With regard to the chemistry and general principles of water softening the writer has little to add to the information already published on this subject, but recommends that no water which contains over 20 parts suspended and dissolved matter per 100,000 of water should be allowed to enter the boiler and that the intermittent type of softening apparatus should be adopted where circumstances permit. The use of boiler fluids and secret compounds is strongly condemned. Gaseous impurities and oil are especially dangerous, and tests for their presence should be regularly carried out. The economy to be gained by close supervision here is that due to fewer stoppages for



Heat-Efficiency Diagram for Steam Boiler and Engine.

scaling and repairs and a prolonged life for the boilers. One of the indirect advantages of raising the water to boiling temperature before admitting to the boiler is that the gaseous impurities are expelled and that internal pitting and corrosion in the neighborhood of the feed-pipe are thereby stopped.

The necessity for care in the use of softening reagents has often been referred to. In a recent case the condensed water obtained from the steam tested acid and it was found that carbonic acid gas was being evolved within the boiler from an excess of sodium carbonate, although caustic hydrate was also present. Two other cases of corrosion due to the unwise use of softening chemicals have come recently under the writer's notice. In the first case a feed water was being treated in the boiler with one of the secret remedies for magnesium scale formation, and little doubt exists that the corrosion observed was due to the excessive use of this boiler fluid with a water that contained only slight traces of magnesium salts. In the second case an impure soda-ash was being employed in the same way inside the boiler, and the corrosive action was attributed to the accumulation of chloride salts in the water contained within the boiler. In this case the feed water was sufficiently pure without any treatment at all, and the money spent on soda-ash was therefore sheer waste. It may not be out of place to remark that the soda-ash which is sold to engineers for water-softening purposes has been found in two cases recently tested by the writer to be adulterated with considerable amounts of sodium chloride. As this salt tends to accumulate within the boilers and to cause trouble in various ways engineers would be wise to purchase their supplies of this chemical direct from the makers under a guarantee as to purity.

As regards the separation of emulsified oil from hot-well or condenser water, engineers who have tried all the ordinary methods of separation and are still troubled with the presence of oil might give an electrolysis separator, known as the Davis Perrett apparatus, a trial.

The principle of this separator is the production by electrolysis of a basic ferrous precipitate, the individual particles of which are positively charged with electricity. The negatively charged oil particles absorb this precipitated ferrous carbonate and aggregate into groups which are easily removed by filtration. Further details of the apparatus and method are given in a paper entitled "The Separation of Oil from Condenser Water by Electrolysis," by R. Ellis, published in the *Journal* Society Chemical Industry, Aug. 15, 1910.

As regards the attainment of the maximum temperature in the boiler feed, the usual plan of procedure is to depend solely upon the economizers for this work. The writer suggests that it would be found more economical in all large plants to combine all types of feed-water heater into one system, water from the hot-well and condensers passing through two or more economizers worked in series on the counter-current plan, and then into the thermal storage vessels, live steam being employed for the last stage of the heating, prior to the water entering the boiler.

The use of live steam would of course be reduced to the lowest minimum possible with the attainment of the desired temperature in the feed water. The feed-water pumps would be placed at such a point in this system that water about 160 deg. Fahr. under a good head would be supplied them; otherwise difficulties in pumping would occur. The water should be filtered just before entering the pumps to prevent damage to the pump barrels by any solid matter that might be present. Where natural draft is relied on for working the boilers the exit gases from the economizers cannot be reduced below 450 deg. Fahr. without spoiling the draft. In many modern plants, however, forced or induced draft is employed and the exit gases can be reduced to a temperature of 220 deg. Fahr. Below this point troubles with condensed water and with sulphur acids will occur.

All portions of the heat recovery plant ought to be thoroughly lagged and insulated against loss of heat, otherwise the efficiency of the apparatus may be reduced 50 per cent. In the writer's opinion the losses by radiation in most boiler plants are well above the 5 per cent at which they are usually estimated. Many engineers in charge would be appalled if they knew exactly what proportion of the total heat of the fuel is being dissipated and lost in this way.

Study of the engraving proves that there exists a very wide field for the exercise of engineering ability in the arrangement and working of that portion of the plant which is designed to recover the maximum possible amount of heat from the exhaust of the engines and from the waste gases of the boilers. Even such a simple change as working the economizers in series on the counter-current system has been known to effect a remarkable increase in the temperature of the effluent water and corresponding reductions in the heat carried away to the chimney.

A reduction of the total heat losses by 10 per cent to 20 per cent can certainly be obtained by use of the usual methods in this portion of the steam raising plant alone, and the writer is by no means convinced that the limits of practicable heat recovery have yet been attained. The laboratory method of testing fuel in a calorimeter suggests many lines upon which further developments may occur.

As a final suggestion for obtaining a higher efficiency from the feed-water-heating plant, the regular cleaning of both the internal and external surfaces of condensers and cooling pipes is recommended, especially in those cases where the water is raised to a temperature of 160 deg. Fahr. or more in the apparatus. The loss due to scale and other deposits in condensers and feed-water heaters is certainly larger than is generally recognized.

LETTERS ON PRACTICAL SUBJECTS

LOCATING BURIED PIPES WITH AN EXPLORING COIL.

The "howler" and exploring-coil method used in testing for electrical faults can be employed successfully in locating underground water and gas pipes when it is necessary to get at these quickly through hard, frozen ground. The principle is familiar to all who have done electrical testing and consists in traversing the pipe to be located with an interrupted current of audible frequency. By moving an exploring coil to which a head-telephone receiver is attached back and forth over the supposed site of the pipe points will be found where the induced characteristic buzz or hum of the current frequency becomes loudest, locating the position of the pipe. The interrupted current for the pipe can be obtained from any make-and-break device, but is most effectively produced by a commutator giving a succession of short breaks, followed by an intermission. This note is distinctive and will not be confused with the sounds due to earth currents from other sources. After the pipe is once located its direction and position can be followed by carrying the exploring loop along the surface of the ground and noting points where the induced hum is loudest. Pipes buried 10 ft. or more beneath the ground's surface can be accurately located by this method, although care must be taken that the test current does not cross to other conductors in the distance located.

Chicago, Ill. C. A. HIERONYMUS.

A LIVE NEUTRAL WIRE.

When on a test for grounds the voltmeter reads 240 volts between one outside live leg and the dead neutral leg of a lighting feeder on the Edison service one would be very cautious about throwing in the switch that controls that feeder. As the service is already grounded a full ground reading should be 120 volts. At a recent ground test of the electrical equipment in a new loft building the switches on the switchboard were individually pulled out and a voltmeter placed in circuit from one live leg to each dead leg of every feeder. All feeders tested clear except one controlled by a 150-amp switch and this read 240 volts. This was a three-wire feeder

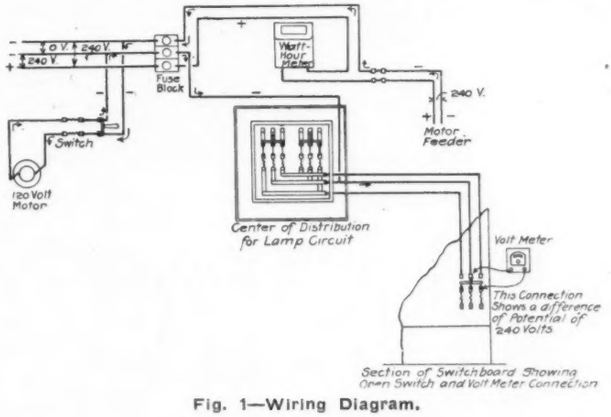


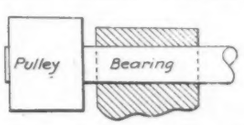
Fig. 1—Wiring Diagram.

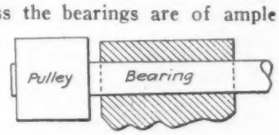
for the lamps on the west side of the building and fed from the switchboard to a center of distribution on the seventh floor, where it split and reduced in size, one section feeding the panels on the seventh to twelfth floors inclusive and the other section feeding the panels on the sixth floor to the second floor inclusive. Each section is controlled by a switch in the center of distribution. The energy is metered on each floor and not at the switchboard. A two-wire motor feeder runs up the same riser shaft as the lamp feeder from the switchboard to a center of distribution on the sixth floor, where it splits and reduces and feeds a 50-amp switch on each of the lighting panels from the second to the twelfth floors inclusive. The energy in this feeder is metered the same as for the lamps except that it is connected directly to the 50-amp switch and from there it feeds to the meter and thence to the line. This motor feeder is outlined because it is involved in the result mentioned. The tenant occupying the seventh floor drives his sewing machines with 120-volt motors. The wiring to these motors was run by an electrician employed by him. To get 120 volts he connected to one of the legs of the motor feeder described and for his ground tapped on the neutral busbar in the lighting center of distribution ahead of the switches and fuses. The motors were very small and were thrown across the line with knife switches. The ground test was made during business hours and the sewing-machine motors were operating. When the lamp-feeder switch was pulled the motors stopped, but remained across the line and therefore raised the potential of the neutral leg of the lighting feeder to that of the outside leg of the power feeder—that is, 240 volts above the opposite outside leg through the armature of the motor. The leg of the motor feeder that supplied these machine motors was not the one that went through the watt-hour meter, therefore the energy was not being metered and the machine motors were run and not being charged against. This was proved by removing the fuse from the leg of the motor feeder that passed through the meter and then operating the machine motors. Under the existing conditions had the motor circuit been connected to the metered leg of the motor feeder the tenant would be charged with twice the amount of energy that he was actually using because the potential of the meter is 240 volts as shown in the diagram.

New York. J. P. MORRISSEY.

FAULTY MOTOR BEARINGS.

The practical application of electric motors has revealed the fact that too often the designers have not been mindful of actual requirements. This is especially true of bearing surfaces, motors being usually constructed with equal bearing surfaces regardless of the fact that one side carries a pulley and must withstand belt thrust and extra strain. The desire to eliminate or cut down the number of patterns and to build a cheap motor is doubtless the cause of this condition of affairs and while the interchangeability of the bearings and housings is an undoubted advantage, unless the bearings are of ample





Figs. 1 and 2—Motor Bearings.

dimensions it is a penny-wise pound-foolish policy to build motors thus. No one would think of purchasing a side-crank engine having both bearings of the same length, and the same condition will obtain in time with regard to motors. Fig. 1 shows how motor bearings are now built for both sides of a machine and Fig. 2 shows the relative dimensions that the bearing on the pulley end of the motor should have. There will then be provided sufficient bearing surface to resist the belt strain and much trouble and annoyance caused by present construction will be obviated.

Baltimore, Md. M. R. CASSIDY.

ELECTRIC PLATE-DRIER FOR PHOTOGRAPHERS.

Photographers, both commercial and amateur, who frequently have need to do work in a hurry and want plates dried quickly after developing, will find an electric heater and an electric fan effective agents in accomplishing this result. For this purpose a wooden chute should be built, at one end of which the plate racks can be inserted, while at the other a coil of

electrically heated resistance wire, in the blast of a small 8-in. fan, is placed. A sliding door can be arranged at the heater end of the chute to vary to the desired quantity the amount of air entering. An electric toaster of the incandescent-wire type, or the coils of an old starting box, will make a satisfactory heating element. The drying chute should be mounted over the developing and fixing tanks so that the plates can be started drying as soon as they come from the last bath. The time then required to dry them thoroughly ready for printing will be surprisingly short to those accustomed to wait on the natural process.

Cleveland, Ohio. JOHN G. WEEKS.

METHODS OF MOUNTING MOTORS ON SIDE WALLS AND COLUMNS.

In wooden buildings motors of moderate output can be mounted on the side walls as shown in Fig. 1. Substantial

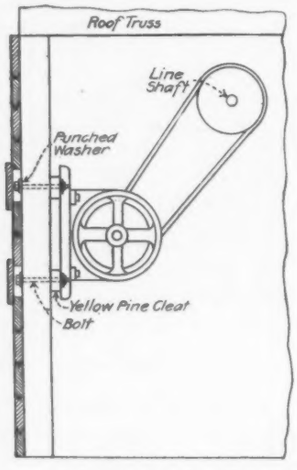


Fig. 1—Motor Mounted on Cleats at Side Wall.

cleats, preferably of yellow pine, are bolted to wall posts and the bed plate of the motor is bolted to these. Lag screws should not be used (unless many can be driven in) because, although they may appear to be quite firm when inserted,

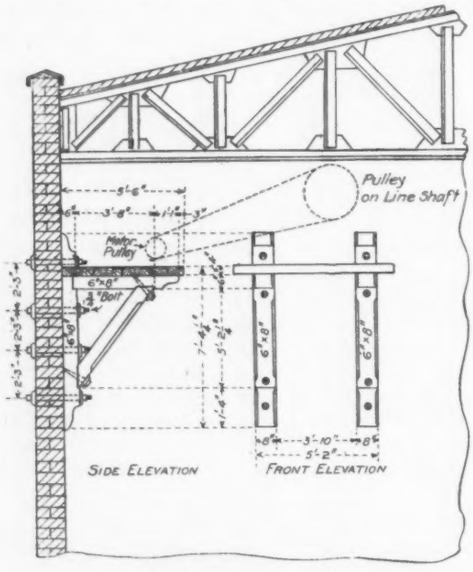


Fig. 2—Wooden Wall Bracket for Motors.

the vibration of the motor tends to loosen them and they may pull out. Bolts securing the cleats will extend entirely through the posts and to the outside of the building. Depressions should be arranged in the outside surface of the wall, as indicated in Fig. 1, into which the bolt heads can be set. Pieces of board should be nailed over the depressions so that water, from rain or snow, cannot drip from the bolt heads and make streaks on the wall. Small motors can, in wooden buildings, usually be bolted directly to the posts or columns. In buildings of weak construction it is sometimes necessary to build wooden frames, extending from floor to ceiling and strongly braced, to carry motors located on side walls. Although such frames

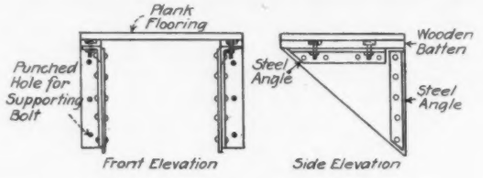


Fig. 3—Structural Steel Bracket Supports.

often rest directly against a wall they are, structurally, entirely independent and self-supporting.

It appears to be the present tendency to mount motors, where they must be located at side walls, directly on the walls, as outlined in Fig. 1, rather than on brackets. When a motor is arranged with its bed plate in a vertical plane the erector should always be certain that the motor end frames are so located.

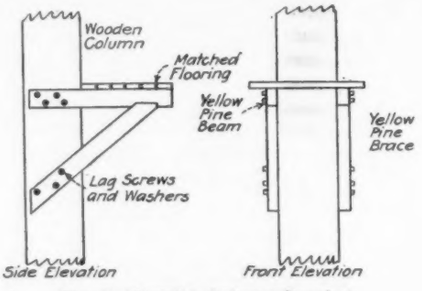


Fig. 4—Wooden Column Bracket.

in relation to the main frame, that the oiling devices will feed properly. It is usually the practice with electrical machine manufacturers to ship motors with their bed plates arranged for operation in a horizontal plane and below the motor frame—that is, the motors are ordinarily shipped for floor mounting. A motor arranged for floor mounting can, as a rule, be adapted for wall mounting by removing the end frames (which carry the bearings), rotating them through an angle of 90 deg. and replacing them.

Some erectors prefer to mount motors located at side walls on brackets. A wooden motor-bracket, designed for mounting on a brick side wall, is illustrated in Fig. 2. Brackets of this design were used for supporting 15-hp and 20-hp motors in

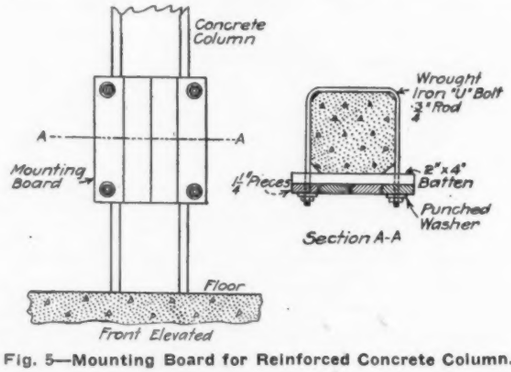


Fig. 5—Mounting Board for Reinforced Concrete Column.

the Omaha (Neb.) shops of the Union Pacific Railroad Company. The bolts supporting the brackets extended entirely through the brick walls and each had a substantial washer under its head.

Where many brackets are to be used it is usually economical to have a pattern made and use bracket supports of cast iron rather than of wood. The pattern for this is easily made

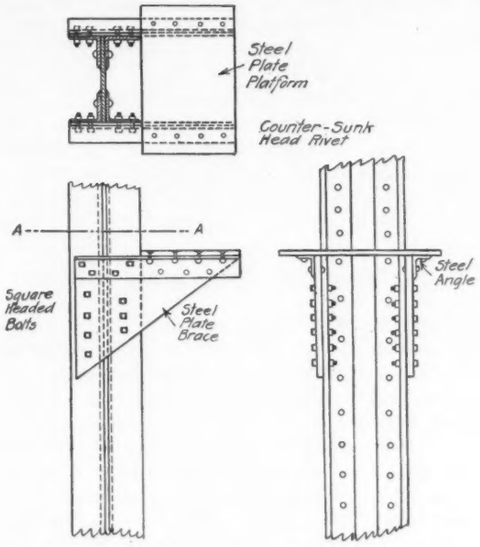


Fig. 6—Structural Steel Motor Bracket and Column.

in one piece. Holes to accommodate the bolts for binding the supports to a wall and for clamping the bottoms, to which the floor boards are nailed, are drilled in the casting by the erector.

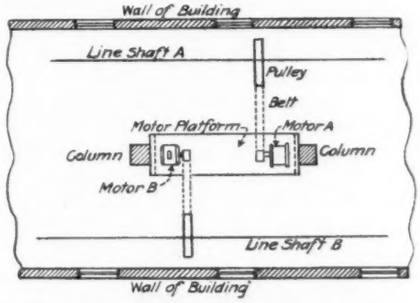


Fig. 7—Motor Platform Between Columns.

Wall-bracket supports can be made of structural steel angles and steel plates, as suggested in Fig. 3. Obviously, steel supports are preferable to cast-iron ones, as for equal strength

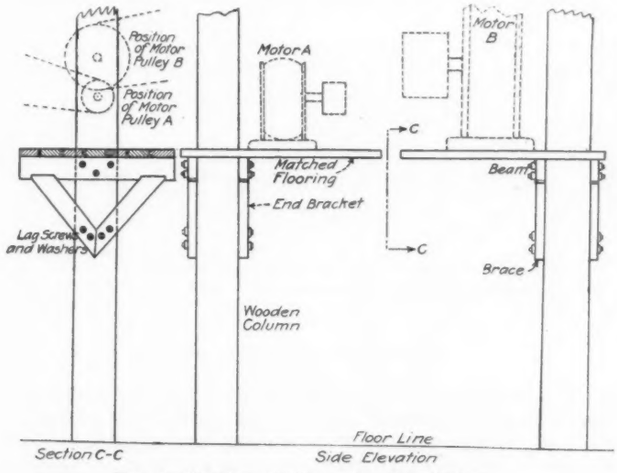


Fig. 8—Wooden Platform for Two Motors.

they are lighter and they are not so brittle. Another point in favor of steel construction is that when it is taxed beyond its capacity it will give an indication of distress before failing, whereas cast iron may crack without warning. Where facilities are available for shearing plates and structural sections and for riveting them together economically steel bracket supports have much to commend them.

Motors are often advantageously mounted on columns. Fig. 4 shows the construction of a simple form of column bracket. This construction can only be used where motors of relatively

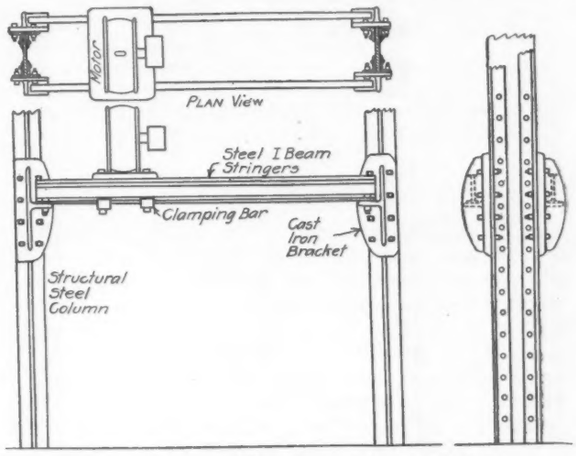


Fig. 9—Structural Steel Stringers and Supports.

small output are involved. The braces and beams are clamped to the column with lag screws, each having a punched washer under its head. Enough lag screws should be used so that there can be no possibility of their working loose. The upper end of each brace is set about ½ in. into the beam and is held there with wood screws. It is well, as a rule, to use matched

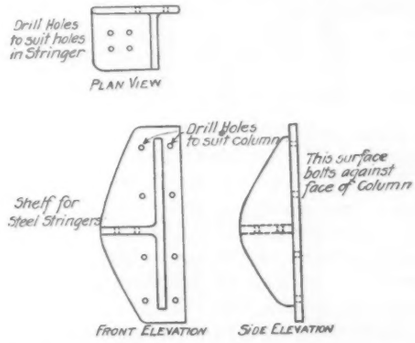

Drill Holes to suit holes in Stringer
PLAN VIEW
Drill Holes to suit column
This surface bolts against face of Column
Shelf for Steel Stringers
FRONT ELEVATION
SIDE ELEVATION

Fig. 10—Details of Cast-Iron End Bracket.

stock for motor brackets. If plain stock is used it ultimately dries out and shrinks, leaving open spaces between adjacent boards for dust, dirt and probably oil to come down continually through the spaces. This is largely avoided where bracket floors are made of "matched" stock. They can then be cleaned systematically by the motor inspector.

In buildings of reinforced concrete small motors can be mounted on a mounting board like that of Fig. 5. It is sometimes advisable when erecting this kind of mounting board to chip out a groove for each of the "U-bolts" in the rear face of

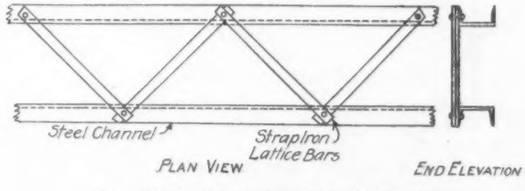


Fig. 11—Latticed Channel Stringers.

the column. By this expedient any tendency for the mounting to slip down the column is corrected. The wood used should be well seasoned so that there will be but little shrinkage.

Starting devices for motors can also be mounted on boards like that of Fig. 5. Obviously lighter construction may be used for these.

A neat and economical bracket for a structural steel column is illustrated in Fig. 6. A steel plate forms the floor or platform and all of the components of the bracket are riveted together. Bolts are used to attach the bracket. A portable, electrically operated breast drill and an "old man" to maintain it in operating position will be found valuable tools where much drilling is to be done in structural steel members already erected. The outfit will pay for itself in a short time. Where a bracket must be attached to the face of a column instead of to its side it can be arranged like the one shown in Fig. 3. Countersunk-head rivets should be used to secure the platform plate. Button-head rivets interfere with the locating of a motor bedplate on a platform.

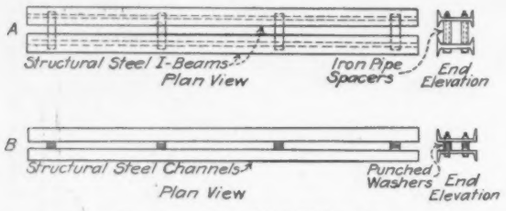


Fig. 12—Assembled Stringers.

It frequently occurs in arranging group drives that two motors can be advantageously mounted on one platform, supported by two columns, as indicated in the plan, Fig. 7. The starting device for each motor can be mounted on the adjacent column near the floor. In a wooden building a platform of this type can be constructed as suggested in Fig. 8. The motors are, if possible, located close to the columns so that the bridge between the brackets can be made of the lightest material possible and yet be stiff enough to carry the motors.

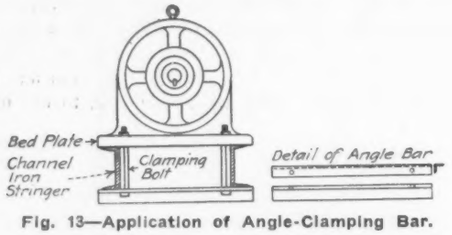


Fig. 13—Application of Angle-Clamping Bar.

Stringers made of structural steel I-beams or channels serve to support motors in steel-frame buildings where two motors can be arranged to drive from between adjacent columns. A typical installation is outlined in Fig. 9. Only one motor is shown on the stringers in the illustration, but another or more could be supported. The feature of this method of mounting is the cast-iron end bracket (see Fig. 10 for detail), which carries the stringers at the columns. End brackets can be made from structural steel, but it is not always possible to make them so they can compete in cost with cast-iron ones. It is usually possible so to design one cast-iron end bracket that it can be used for a majority of applications about a plant. Different drillings will be necessary to adapt the brackets for different columns and stringers, but the same pattern and castings can be used for all. In designing such an end bracket it should be made sufficiently strong to carry the largest motors that it will ever be called upon to bear. This procedure will render it excessively heavy for supporting small motors, but, unless there are many small motors, it will be more convenient and probably more economical to make all end-bracket castings from the same pattern. It should be noted that the pattern is of one-piece construction and is easily and cheaply made.

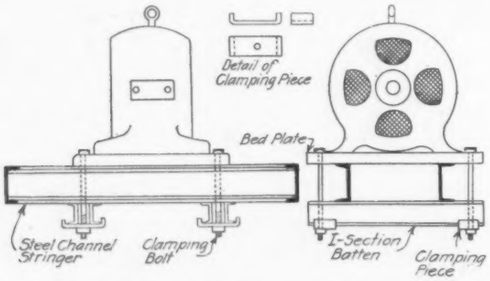


Fig. 14—Channel-Clamping Bars.

No floor is necessary with the construction shown in Fig. 9. The motor bedplate is clamped to the stringers, possibly by one of the methods suggested in Figs. 13 and 14. These will be discussed later. The stringers may be single channels (Fig. 11) or single I-beams, or they may be assembled from two or more channels or I-beams, bolted together, as detailed in Fig. 12. If stringers are long and lateral deflection is feared the members may be reinforced with lattice-bars, as shown in Fig. 11. In the assembled stringers of Fig. 12 short lengths of pipe are used as spacers in the member *A*, which is composed of I-beams, and punched washers are used for *B*, which is made up of channels. If many assembled stringers are to be used it may be cheaper to have regular spacers made of cast iron than to use the pipes and washers.

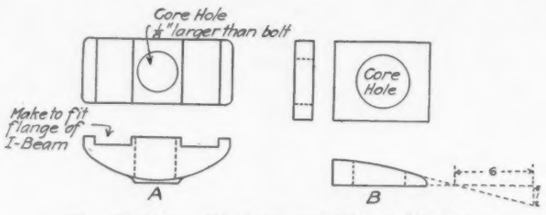


Fig. 15—Beam Washers and Flange Washer.

One of the simplest methods of clamping a motor to steel stringers is outlined in Fig. 13. A length of angle iron, properly drilled, is used for a clamping bar and standard bolts passing through the motor bedplate hold the components in correct relation. The method shown in Fig. 14 is sometimes uesd where large motors are involved. In this case small channels, possibly 3 in. or 4 in. deep, are used for clamping bars. A clamping piece (see detail in Fig. 14) forged from a wrought-iron bar is used to prevent the clamping bars from spreading. If enough will be used to make it worth while to have them cast I-beam washers of iron, similar to that of Fig. 15 *A*, should be used instead of the forged-iron clamping piece shown in Fig. 14.

Sometimes it is convenient to bolt a steel plate for supporting a motor to stringers, as shown in Fig. 16. The plate is drilled for the bolts that hold down the motor bedplate. Flat-head bolts should be used for attaching the platform plate to the stringers so that there will be nothing extending from its surface to interfere with the lateral adjustment of the motor. Flange washers (Fig. 15 *B*), which are beveled to fit the insides of flanges of I-beams and channels, are used under the nuts of the flat-head bolts.

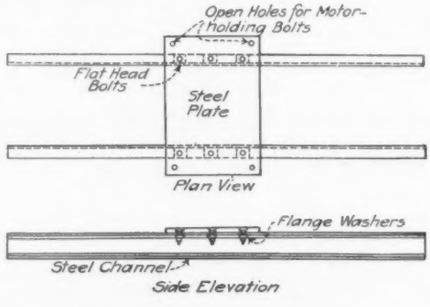


Fig. 16—Steel Plate Platform.

Pittsburgh, Pa. H. F. Bearnes.

QUESTIONS AND ANSWERS

How may the resistance used in starting boxes for motors be calculated? R. K.

The method for calculating the resistance of a motor-starting rheostat depends largely upon the type of motor with which the rheostat will be used. The resistance of a starting rheostat for a series motor would be proportioned somewhat differently from that for a shunt motor. Assuming that you have in mind a shunt motor, it may be stated that the value of the resistance inserted between adjacent notches on the rheostat depends upon the resistance of the armature and the permissible fluctuation in the current. If the current is to be allowed to fluctuate by 50 per cent, then the final section of the rheostat should have a resistance equal to 50 per cent of that of the armature, the next to the last should have a resistance equal to 75 per cent of that of the armature, the second from the last should have a resistance of 112 per cent of that of the armature, the next step 168 per cent, etc. If a variation of only 25 per cent is permitted, the last step on the rheostat should have a resistance equal to one-fourth of that of the armature, the next step should be 31 per cent of the armature, the next 39 per cent, the next 49 per cent, the next 61 per cent, etc.

We deliver 133-cycle energy a distance of one mile, using a 500,000 circ. mil cable. Tests show a 7 per cent drop with two-thirds load (60 amp at 1100 volts). The wires are 16 in. apart and 20 in. from circuits carrying similar current. We contemplate changing the cable to a solid wire and also contemplate installing three step-up transformers, each rated at 60 amp, 1100 volts, to raise the voltage to 2200, or else renew three circuits to a distance of one mile from the power house to carry 60 amp at 1100 volts. The present circuits are of No. 1 and No. 2 wire and 500,000 circ. mil cable. What would be the loss in the three transformers as compared with the line loss with the circuits carrying 2200 volts? What would be the skin effect? H. S. T.

The skin effect due to eddy currents is relatively negligible in a 500,000-circ. mil cable when operated at 133 cycles. Even in a solid conductor of this size, the diameter of which would, of course, be about 7/10 in., the eddy-current effect would tend to increase the resistance by somewhat less than 10 per cent, so that even with a solid wire the effect can be neglected. A standard transformer for raising the e.m.f. from 1100 volts to 2200 volts would suffer a loss not greater than 1320 watts. If a two-to-one ratio transformer were used as an auto-transformer the loss could be reduced to perhaps 600 watts. If the latest type of silicon-steel transformer were employed the loss could probably be reduced to even below 700 watts. When transmitting 60 amp over a total length of 10,000 ft. of No. 1 wire the loss would be 4500 watts; with No. 2 wire the loss would be 5800 watts. With a 500,000-circ. mil conductor the loss would be 720 watts. If the e.m.f. were doubled and the same size of conductor were employed as before, the loss in each case would be reduced to one-quarter of the value just stated. Thus, if a transformer were employed on the No. 2 circuit the loss in the circuit would be reduced from 5800 watts to about 1500 watts, to which, of course, must be added the loss in the transformer, which might perhaps equal 1000 watts, giving a total of 2500 watts instead of 5800 watts.

Is it correct to assume that the mutual force between any two wires and the third in a three-phase system is proportional to the instantaneous current value, that is, that it varies at the same frequency as the line current? What is the maximum value of the force between two conductors in a 60,000-volt three-phase circuit with wires spaced 84 in. apart when the current is 100 amperes per wire? W. S.

The force exerted upon a unit length of any conductor carrying a current in a magnetic field is equal at each instant directly to the product of the field density and the current strength, all values being expressed in c.g.s. units. At any distance d from a straight conductor carrying a current i the flux density in air is equal to $2i \div d$, expressed in c.g.s. units. In the case of a straight conductor carrying 100 amp (10 c.g.s. units of current) the flux density at a distance of 84 in. (213 c.g.s. units of length — cm) the flux density would be $20 \div 213 = 0.094$ c.g.s. unit (line per square centimeter). The force exerted upon a conductor at this point carrying 10 c.g.s. units of current would be $10 \times 0.094 = 0.94$ dyne per centimeter of length, or about 0.000063 lb. per foot of length, tending to cause the conductor to cut across the flux. When either the field or the current varies the force varies accordingly; when they both vary simultaneously and sinusoidally at a certain frequency the force varies at double this frequency and reaches a maximum value equal to double the value calculated for the mean effective value of the current and flux. In a three-phase system the force exerted upon each wire varies both in time and in direction, as can be calculated from the above considerations. In any event even with the closest spacing of the wires the force is truly negligible in any transmission system.

In operating in parallel our two 2300-volt, three-phase alternators in separate stations, we find on trial that when the excitation on one machine is so adjusted that the machine delivers a minimum current, the power factor of this machine rises to about 100 per cent, while that of the other machine falls to about 55 per cent. For example, with 160 kw on the first machine the excitation can be reduced so that the machine will deliver 40 amp per lead. At the same time the other machine, with a load of 220 kw, has a current of 100 amp per lead. As the excitation on the first machine is decreased the current of the other machine increases, but the sum of the currents of the two machines is not constant. Should the excitations be adjusted for equal power-factors or for minimum currents? G. E. M.

In a three-phase system with an e.m.f. between leads of 2300 volts each kilovolt-ampere requires ¼ amp in each lead. A load of 160 kw requires 40 amp in time-phase with the e.m.f. and such additional current in time-quadrature therewith as is necessary to supply the wattless kilovolt-amperes demanded by the load. At 220 kw the power component of the current is 55 amp; when the indicated current is 100 amp the wattless component must be $\sqrt{100^2 - 55^2} = 83$ amp. Neither the power component of the current of each generator nor the total wattless component of current delivered to the system can be altered in any respect by varying the excitation of the two generators, provided the resultant e.m.f. remains at 2300 volts, the load on the system does not vary and the prime movers are not changed. However, the wattless component can be shifted from one generator to the other at will or can be divided between them in any desired proportion. If the machine with the smaller load carried all of the wattless current its indicated current would be $\sqrt{40^2 + 83^2} = 92$ amp and its power-factor $40 \div 92 = 0.435$; the other machine carrying only 55 amp, the apparent total of the two machines would be 147 amp. If the wattless current were so divided that the smaller machine carried 40 amp and the larger 43 amp, the indicated current of the former would be $\sqrt{40^2 + 40^2} = 56.6$ amp with a power-factor of 0.707, and that of the latter $\sqrt{55^2 + 43^2} = 70$ amp with a power-factor of 0.787; the apparent total would be 126.6. In the case cited the apparent total was $40 + 100 = 140$ amp. Thus one should expect a considerable variation in the apparent total of the currents delivered by the machines when the relative excitations are varied. The minimum apparent total is obtained when the wattless current is divided between the two alternators in proportion to the power components which these machines carry—that is, when the power-factors of the two machine loads are equal. For minimum loss of power by the currents in the generator circuits the wattless current should be divided between the generators in such a way that the sum of the square of the separate parts multiplied by the resistances of the generator circuits is a minimum; such an adjustment would depend solely upon the value of the wattless component of the load current and would not be affected otherwise by the value of the power component. However, such a method represents an unnecessary refinement. Ordinarily if the power-factors of the separate generators are adjusted to equality by means of power-factor meters the loss will be kept sufficiently low. The excitation of two widely separated generators in a system where the load power-factor is high and can be adjusted by setting one of the generators for the minimum current by means of an ammeter, thereby eliminating the necessity for a power-factor meter.

Central Station
Management, Policies and Commercial Methods

ICE CREAM AS CENTRAL-STATION BY-PRODUCT.

In conjunction with its 200-kw electric plant the Nashville (Ill.) Electric Light Company operates a refrigerating outfit with a daily capacity for freezing eight tons of artificial ice. An unusual adjunct of the central station, however, is an ice-cream plant for which the ice-making capacity of the station is largely utilized. The ice-cream machinery has a daily output capacity of 400 gal. of ice cream.

ELECTRIC TRUCK GARAGE TO BE ESTABLISHED IN BOSTON.

The Edison Electric Illuminating Company of Boston will shortly establish a garage for electric trucks in the Atlantic Avenue district of the city as a preliminary to the inauguration of an active campaign on behalf of the commercial storage-battery motor vehicle. The garage is to be the first in the city for electric trucks exclusively and will also be operated as the first sanctioned garage of the Electric Vehicle Association of America. The initial capacity of the garage will be twenty-five vehicles, with provision for double that number later. Expert attendance will be provided by the company, and if the public responds to the work in behalf of electricity it is probable that the company will open an uptown garage for pleasure-vehicle service. A campaign of education to instruct the public in the advantages of electric motor wagons will be pushed.

The Boston Edison Company has been a user of both gasoline and electric automobiles for a long period, but has only recently decided entirely to eliminate horses in its service. Orders have been placed which will practically quadruple the present electrical equipment, making the company the owner and user of thirty-nine trucks. Of these fifteen are to be employed in the downtown sections and the remainder in the suburban districts. Among the new trucks will be a derrick wagon for use in pole erection. The company has been remarkably free from troubles in its electric vehicle service which are capable of withdrawing it from operation. At present about forty electric trucks and delivery wagons are in service in Boston and the outlook for larger developments is most attractive Among the recent purchasers of electric trucks is the American Express Company, which has decided to give this type of equipment a thorough trial in exacting service.

HINTS ON MARKETING CENTRAL-STATION ICE.

Mr. H. L. Titus, manager of the Sterling Consolidated Electric Company, of Sterling, Col., which operates a 10-ton ice-making auxiliary in connection with its 225-kw electric plant, advises central-station men contemplating ice manufacture to arrange for the sale of their product directly to the consumer from their own office, without recourse to a contractor or other delivery middleman. In this way complaints come directly to the office of the electric company, which can thus keep in closer touch with its customers, better increase its business and by careful selection of drivers keep complaints at the minimum and get more satisfactory service than by selling ice at the platform under a contract.

Mr. Titus testifies that ice-making forms an excellent load for an electric plant, since during the ice season proper, when the refrigerating apparatus must be operated continuously throughout the twenty-four hours, the electrical demand is at a minimum. As the fall electric lighting load increases the ice-making duty required of the plant falls to less than six hours a day, while during the winter months three hours' operation is found sufficient to hold down the temperature in the storage-room and freeze all the ice that is necessary for the trade.

The ice-making auxiliary at Sterling operates twenty-four hours a day during three months of the year and for the remaining months several hours a day. The population of Sterling is 3300, and during the past season, the first in the experience of the local company, an average output of 18,500 lb. of ice per day was made at the plant. This was sold retail at 50 cents per 100 lb., wholesale at 35 cents and in carload lots at 20 cents.

FLATIRON RENEWALS FREE.

A few years ago it would have been hard to find central-station men who would entertain the idea of maintaining electric flatirons for consumers and renewing their various parts, following the practice in regard to free renewals of carbon-filament lamps. Nevertheless, the developments of the last five years have brought this idea into consideration, and in fact many companies have virtually adopted the plan either tacitly or openly. Until a comparatively few years ago the electric flatiron was but little used and was considered as an article with a rather uncertain life and expensive to renew as to its heating element. Later, more durable irons were produced and central-station companies succeeded in introducing them in large quantities and in adding materially to their revenue from residence consumers thereby. In order to foster this business the companies in many cases either guaranteed the irons or, without making any promises, as a matter of fact, renewed the heating elements and worn-out or defective cords or plugs. It was found that consumers having irons might neglect to get them repaired promptly if out of order, and that the iron would be laid aside on the shelf for fear of the expense incurred in getting it fixed or until a convenient opportunity offered. The central-station manager realized that irons standing on the shelf were earning him no revenue, and as a result some companies have settled down to the practice of keeping consumers' irons in working condition, just as they make periodical renewals of lamps. The first cost of renewal parts on electric irons is really lower than on any other electric energy-consuming device in proportion to the energy it consumes. In other words, the company can really better afford to spend money on maintaining consumers' irons than on the maintenance of any other consumers' appliance.

ILLUMINATING PROBLEMS IN SMALL TOWNS.

The symposium on illuminating problems in small towns held at the last meeting of the Chicago Section of the Illuminating Engineering Society showed a notable agreement of opinions on one point, namely, that the illuminating engineering problems in the small towns are up to the central-station company for solution in the great majority of cases. While most of the speakers agreed that it is frequently difficult to get electric light users in small towns properly to arrange and equip their lamps to get the best results, nevertheless, continued effort along this line by the central-station company invariably leads to good results in improving the general conditions prevailing in the town and increasing the percentage of the total lighting business done by the electric light company.

An instance was cited where the central-station manager said it was hopeless to try to get rid of gasoline plants in the commercial district, as he had tried it for six years without success. A new manager with proper enterprise and knowledge of proper methods soon had most of the gasoline plants put out of business. It is, of course, true that the contractors in some towns are more alive than the central-station company, but as a general rule the initiative must be taken by the company.

BALTIMORE ELECTRIC GARAGE.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, will open a large garage on March 1 in which to charge commercial electric vehicles and store vehicles for such owners as desire it, taking care of the motors and making all repairs. The building, which is located at 30 South Eutaw Street, fronts 100 ft. on Eutaw Street and is 200 ft. deep. In addition to the storing, charging and repairing of electric-driven vehicles the company has entered the sales end of the motor-vehicle business and has obtained the Baltimore agency of the General Vehicle Company, of Long Island City, New York. Trucks will be kept on exhibition and ten trucks for the company's own use will soon be in use. The many advantages possessed by the electric as compared with the gasoline trucks, of which latter it has several in use, have led the company to decide upon the electric to displace almost all of its horse-drawn vehicles.

TRANSMISSION SYSTEM SERVING SMALL TOWNS NEAR RADCLIFFE, ENGLAND

To serve a number of small towns and farming communities in Mid-Lancashire, England, an electric generating station has been built at Radcliffe and a network of 10,000-volt transmission lines carried in several directions for a radius of fourteen miles over the countryside. Among the villages served is the farming town of Ainsworth, a little place too small to support an electric plant of its own, but now enjoying all the modern advantages of its big urban neighbors. Ainsworth is four miles from the generating station at Radcliffe, and the transmission potential of 10,000 volts is reduced by local transformers to the 230-volt distribution pressure. Lighting is furnished many householders virtually on a flat rate at 26 shillings ($6.50) a year for four lamps. The landlord or owner of the group of houses purchases this energy through a meter, and usually profits slightly by the difference between his meter reading and his flat-rate sales. The average cost of operating a single lamp as many hours as desired during the year is reported to be $1.25. Wiring of houses or cottages costs from $3 to $4 complete with lamps, it is declared, and even the payment of this amount may be distributed over several months. The wiring used is described as being run "along the outer walls, supported by staples," and doubtless would hardly be permitted under American wiring regulations.

The street lighting of Ainsworth is to cost $13 per 59-cp lamp per year on a ten-year contract, at the expiration of which the lamps, standards and lines will become the property of the parish and charge will be made for energy only. These lamps are also installed along the country roads at 180-ft. intervals. Barns, stables, dairies and farm buildings of all kinds are now lighted by electricity and motors are used to do much of the mechanical work about the places.

A butcher in Westboughton (at the easternmost point of the company's area) works his sausage machine by electricity with a ¾-hp motor at an average cost, as reported, of less than 2 cents a week. The installation, including motor, cost $70. His neighbor, a shopkeeper, keeps seven lamps burning until late hours at night at a cost of less than 25 cents a week. The installation and wiring of the shop cost, with lamps, about $25, repayment of which is spread over a term of years. This compares strikingly with the lighting charges of most village gas companies in England.

It is the experience of neighboring urban districts which has led rural Ainsworth to take up electricity, and its action, small though it may seem, may prove a notable factor in the revival of English village and agricultural life. This pleasing example of the obtaining of electric service by small rural communities, it must be remembered, is due to the combination of a number of small village needs into a real metropolitan demand.

FUEL SAVING BY REARRANGEMENT OF ICE APPARATUS.

A saving in fuel amounting to at least half of that previously burned has been gained by the Yorktown Electric Light & Ice Company, of Yorktown, Tex., as a result of rearranging certain of the parts of the ice-making equipment originally furnished. This company has a ten-ton ice plant in conjunction with its 60-kw electric generating station. The ice machinery is operated for 100 days each year, during which period it produces about 5000 lb. of ice per day. Yorktown's population is 2000.

After replacing a producer-gas engine by a Corliss steam engine for driving the electrical generator it was decided to substitute a similar Corliss gear for the slide-valve engine running the ammonia compressor. At first this change was advised against, as it was feared that the lower water rate of the more efficient engine would not pass enough steam to supply distilled water for ice making. The experiment was then tried of mixing an equal quantity of well water with the distilled water. By subsequently reboiling and filtering this mixture a good clear quality of ice was produced. This showed that the more efficient Corliss engine could be substituted as far as the production of raw material for ice making is concerned, and the change at first contemplated is now being made.

Another experiment also showed that the exhaust-steam line could be used for reboiling the distilled water practically as well as the high-pressure live steam direct from the boilers. This change resulted in economy in the amount of steam used for the auxiliary purpose of preparing the raw water for the freezing tanks. It was also shown that the cooling water from the ammonia condenser could be used to advantage for cooling the steam condenser, on account of the wide difference in temperature ranges of the two pieces of apparatus. This modification was, of course, accompanied by a substantial saving in the quantity of circulating water required. Part of the cooling water coming from the ammonia condenser is also used to jacket the oil separator in the condenser exhaust line, the lower temperature at which the separator is thus maintained making it operate more efficiently in removing oil from the steam.

ICE-MAKING PROFITS OF A SMALL CENTRAL STATION IN THE MIDDLE WEST.

The combination ice-making and electric-generating plant in a small Middle-Western town of 3500 inhabitants, in about the same latitude as Topeka, Kan., is operated from a common set of steam boilers, and as the electrical machinery is in service twenty-four hours per day the refrigerating equipment is operated with very little additional labor and at a correspondingly low cost. In fact, in this instance, the ice-making business has proved to have even a larger earning capacity on an investment basis than the electric plant itself, although the use of electric service in the little city for lighting, motor drive and heating has meanwhile been developed to a record-breaking extent.

The absorption plant installed has a rated capacity for producing ten tons of ice per twenty-four hours, and averaged this output during the past season, except during the warmest portions of July and August, when eleven tons per day was

pulled. Since it is during these warm months that ice brings the highest prices it will be readily understood that the overload production of the plant at this time is especially significant in raising the earning capacity of the station.

During the months of June, July, August and September, 1910, the plant produced 2,194,180 lb. of ice, which, at the current retail prices (ranging from 30 cents to 50 cents per 100 lb., according to quantity), brought in $6,883.13, or an average of $6.36 per ton. The total cost of producing this quantity of ice and delivering it to the consumers was $3,338.08, or an average of $2.95 per ton. During this time it should also be understood the coal scarcity due to the strike was at its worst, and some of the fuel used to produce the ice mentioned above cost as much as $3.50 to $4 per ton, delivered in the bin, for a very poor run-of-mine quality.

From the preceding figures it is seen that the profits on the ice for the four months amounted to $3,545.05. After deducting fixed expenses of $391.87, which includes charges to cover insurance, taxes, etc., this leaves $3,153.18. Charging 5 per cent for depreciation on the $17,500 investment shows a net profit during the four months of $2,300, representing at once a 13 per cent return on the $17,496.23 invested. Considering the additional service rendered by the refrigerating plant, it is probable that even this pleasing rate of return was exceeded.

The schedule of prices under which the above ice was sold follows: Retail to the small consumer, 50 cents per 100 lb.; where two tons per month are used, 40 cents; over four tons, 35 cents, and over eight tons, 30 cents. All of the excess ice over and above the requirements of the town was sold in car lots at $3.25 per ton.

Installed in the plant are two 2200-volt, two-phase, 60-cycle engine-driven alternators aggregating 140 kw, supplied with steam by 250-hp rating in boilers. Such an electric plant in combination with an ice plant is undoubtedly a paying proposition, since summer is the season when the electric plant is at its low point in load. At this time the ice plant helps over this valley in working the boilers up to winter efficiency and giving profitable employment to men drawing full pay but who would otherwise not be rendering full value to the company. The combination is a happy one, declares the local manager of the company, and adds that it will undoubtedly be adopted by many small plants within the next few years.

REPLACEMENT OF STEAM POWER BY CENTRAL-STATION SERVICE FOR MILL AND ELEVATOR OPERATION.

By R. B. Mateer.

Not many years ago flour mills and grain elevators were located upon navigable streams. The waterwheel was found practicable for power purposes. But the advent of the railroad necessitated locating mills and elevators along the "bands of steel" which link States together. Junction points located in the grain-growing sections always boasted of grain elevators; these were tributary to the large elevators and mills located at railroad centers.

The Longmont Farmers' Mill & Elevator Company, with a number of elevators in the Rocky Mountain district, operates, among others, a large mill and elevator in Denver, Col. Originally a steam plant was installed in this mill, complete with generator for lighting purposes. The machinery consisted of one 250-hp Allis-Chalmers compound engine operating the roller mills used in grinding flour. The rope-drive connection used has proved very efficient. A 100-hp Allis-Chalmers engine was belted to the line shaft driving the elevator and the lighting generator. The three 125-hp boilers were fired with fuel from the northern Colorado fields.

Prior to June, 1909, it was necessary to fire the entire battery of boilers as long as the mill and elevator were to continue in operation. Desire for increased efficiency in plant operation, however, led to the making of a careful inspection of the existing equipment by the power department of the Denver Gas & Electric Company, which recommended that the mill continue to be operated for the present by the 250-hp engine, but that the small engine and generator be shut down and a 100-hp, 2200-volt motor be installed in the basement of the elevator for the operation of that portion of the equipment. It was further

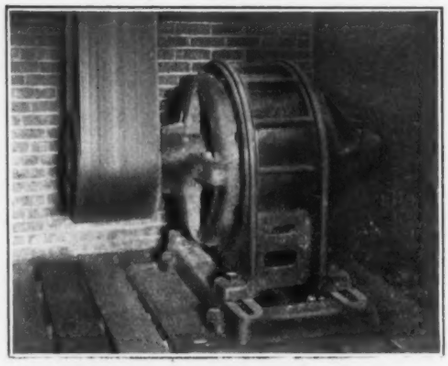


Fig. 1—2200-Volt, 100-hp Motor Driving Grain Elevator.

suggested that milling and elevator expenses, so far as mechanical drive were concerned, be segregated.

The motor, one of the first 2200-volt machines operated from the primary circuit to be installed, fulfils all expectations. Whereas the engine previously operating the elevator was frequently out of service and unable to carry the load the 100-hp motor now handles easily all the load occasioned by the grinding, elevating and storing of the grain. Among the machines driven by the motor are a 30-in. Trition mill grinding 20,000 lb. of corn per hour; a roll for corn; a roll for barley; a cockle machine; screens; a 24-in. elevator; thirteen 10-in. elevators; a freight elevator; a scoop for unloading cars, and a car winch. The Trition mill requires from 50 hp to 60 hp; the rolls from 10 hp to 15 hp each; the 24-in. elevator 9 hp, and the other machines from 20 hp to 30 hp.

As a result of central-station drive, greater efficiency, decreased operating expense, greater output, more uniformly

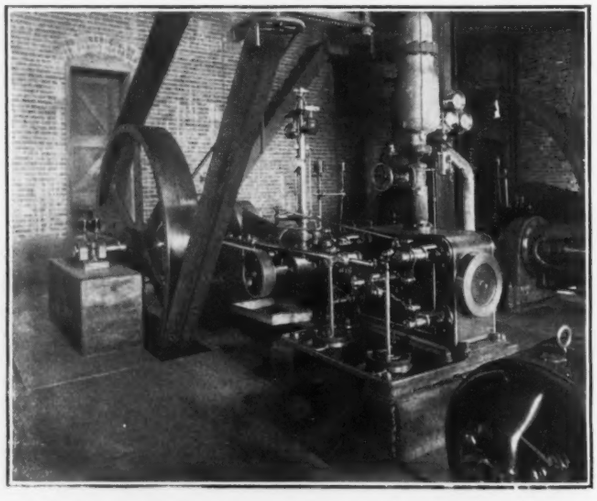


Fig. 2—100-hp Corliss Engine Replaced by Motor for Driving Grain-Elevator Machinery.

ground product and the elimination of some line shaft losses are noted. Two boilers now operate the mill with ease, the third one becoming a spare unit. The 22-kw engine-driven generator is now out of commission, all the lighting throughout the mill and elevator being supplied from the central station. A 300-lamp roof sign now operates upon central-station service from dusk to midnight each night in the year advertising the

brand of flour manufactured in the mill and testifying to the value of central-station service supplied by the Denver company. Lastly, as a result of the change, this mill, designed for 600-bbl. capacity, now produces 700 bbl. of flour per day.

ACID FUMES CAUSE REPLACEMENT OF ARC LAMPS BY TUNGSTENS.

For a number of years arc lamps were used to illuminate the plant of the Alan Wood Iron & Steel Company, at Conshohocken, Pa., but, owing to the sulphur fumes liberated in some of the reduction processes, much trouble was experienced with the feeding mechanism for the electrodes. Recently it was decided to substitute incandescent lamps, following the advent of high-efficiency large units. Four-lamp tungsten fixtures finished in porcelain-enameled steel were installed, and since that time no further illumination trouble has been noted.

Wiring and Illumination

WIRING OF FINE HOUSES WITHOUT DISTURBANCE.

At a recent meeting of the Commonwealth Edison Branch of the National Electric Light Association in Chicago Mr. J. C. Manley commented on the fact that the construction department of his company had wired many of the finest residences in Chicago without disturbing the occupants by any general tear-up of the house. In many cases they had wired under the finest hardwood floors, and after they had left it had been impossible for any but an expert to determine where the boards had been removed and how the work had been accomplished.

SIMPLIFYING CONCEALED CONDUIT WORK.

BY T. W. POPPE.

It seems strange that after several years' use of rigid conduit in a progressive and inventive country the bending of conduit for concealed work is still adhered to. Special fittings are manufactured which greatly simplify the installation of exposed conduit. But no genius has turned his talent toward simplifying the installation of concealed conduit. There is no doubt a great saving of time would be effected if a fitting could be manufactured which would obviate the necessity of bending the several conduits which go through the concrete floor to the lamp outlet on the ceiling below.

For example, when installing conduit in a fireproof building where the arches or bays are made of concrete, the plan now followed is to run the conduit from outlet to outlet while the concrete mixture is still soft. This means that one conduit must enter the outlet and one must leave it. As the

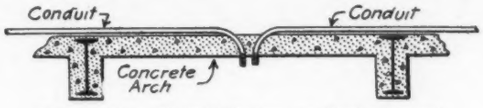


Fig. 1—Correct Installation of Bent Conduit.

wooden forms which support the concrete mixture must necessarily remain in position until the concrete mixture has hardened, a hole must be cut through the wooden form at the position where the outlet is to be located and the bent ends of the conduits placed therein. It is manifestly impossible to place the outlet box in position at this time owing to the wooden form. The laying of the conduit while the concrete filling is being placed saves much time, as it is a laborious process cutting through the concrete after it has hardened. With the present system of bending conduits it is also a bad method, as the wheeling of barrows and the traveling of laborers and mechanics over the loose conduits throw them out of position and produce the condition shown in Fig. 2.

Where such a condition exists it is an expensive job to cut the hardened concrete around the displaced conduits and bend them into a position where an outlet box can be attached to

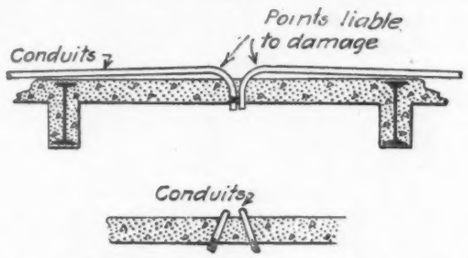


Fig. 2—Improper Position of Conduit and Bends.

them. It also invariably means that the outlet is moved from its correct position and the symmetry of the entire work destroyed.

The bending of conduit is also a laborious, time-consuming process, as the bends must be made about 5 in. from the end of the conduit because the concrete arches are seldom made more than 4 in. thick. If a larger bend is made the conduit

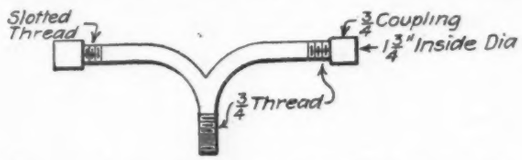


Fig. 3—Fitting Designed to Avoid Bending of Conduits.

projects upward and is more liable to damage from wheelbarrows and other causes. Figs. 1 and 2 show a correct and an incorrect installation of bent conduits.

In exposed work the bending of conduit by the use of fittings on the market can be wholly eliminated if desired and the work made as satisfactory as by the older method of bending the conduit. The drawing in of the wire becomes a simple

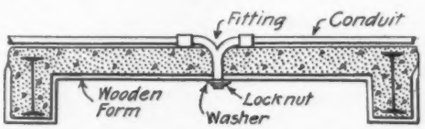


Fig. 4—Fitting in Position in Conduit.

task also. Fig. 3 shows a fitting the use of which will obviate the bending of conduits and which also provides a strong, substantial fixture support. The fitting, which can be made of malleable iron to withstand rough handling, is equal in external diameter to the standard ¾-in. conduit. At each horizontal end the inside diameter is enlarged to 13/16 in. to a depth

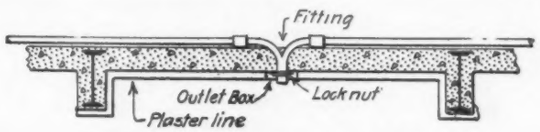


Fig. 5—Fitting and Outlet Box in Place.

of 1¼ in. This allows the standard ½-in. conduit to slip into it. On each horizontal end a ¾-in. pipe thread is cut to a point 1½ in. from the end. Each end is then cut its entire threaded length, the cut being 1/16 in. wide. The thread will allow a standard coupling to be screwed upon it. When the coupling is screwed on it compresses the sections of the thread divided by the one-sixteenth cut and grips the ½-in. conduit, which is pushed into the fitting. After the conduit is pushed

into the fitting and before the coupling is screwed on an application of white lead or other water-resisting compound should be made to the thread. When the coupling is screwed on the thread it forces the white lead or other compound into the crevice formed by the cut and makes a waterproof joint as required by the Underwriters.

The use of this fitting not only obviates the bending of the conduits, but it also saves the cutting of many threads. Under the present system the conduits are bent as desired, then measured and taken to a vise, where they are cut and threaded. With this fitting the conduit can be cut where the fitting is being installed and as no thread is required the conduit can be pushed into the fitting, white lead applied and the coupling tightened. A hole 1¼ in. can be bored through the wooden form sustaining the concrete mixture and the vertical portion of the fitting placed therein. A washer can be placed over it and by screwing a locknut on the vertical end, which is also threaded, the fitting and conduit can be firmly clamped to the arch. Fig. 4 shows a fitting in place.

When the wooden forms supporting the concrete are removed the locknut and washer can be removed and an outlet box placed in position by slipping it over the fitting, using the center of the box and forcing it against the concrete by means of a locknut. After the plastering is finished the rigidity of the box is greater because of the hardening of plaster surrounding the box. Fig. 5 shows a fitting and outlet box in position.

DAMAGE TO CHESTNUT POLES BY WOOD-BORING INSECTS.

The Bureau of Entomology of the Department of Agriculture has recently determined through special investigations that serious damage is being done to the bases of standing chestnut poles in certain localities by the grub or larva of a wood-boring beetle. The character and extent of the damage under different conditions of site in several localities have been determined, and the poles treated with various preservative substances have been inspected to compare the efficacy of both chemicals and methods of treatment. These investigations have resulted in the determination of practical methods of preventing injury to poles by wood-boring insects.

In May, 1910, in addition to the study of the insects involved, investigations were conducted in co-operation with telegraph and telephone companies in the District of Columbia, Maryland, Virginia, Pennsylvania, New York and New Jersey. Through the courtesy of the Western Union Telegraph Company several telegraph lines were inspected in Virginia where the poles were being reset or replaced. The butts of over 200 poles set under different conditions of site were thoroughly examined for insect damage, and sometimes the entire pole was split open. In one line, ten to twelve years old, approximately thirty chestnut poles per mile, 25 ft. long, 6 in. diameter at the top and 10 in. at the base, and apparently of second quality, serious damage by the chestnut borer rendered from 15 per cent to 20 per cent of the poles unserviceable. In another line examined serious damage by this borer on 30-ft. poles averaged about 10 per cent or 15 per cent; and, according to a lineman, 50 per cent of the poles between Boykins, Va., and Welden, N. C., are badly decayed near the surface of the ground. Much of this damage, however, is due to fungous heart rot.

The chestnut-pole borer is a creamy white, elongate, stout, cylindrical, so-called round-headed grub or wood worm which hatches from an egg deposited by an elongate, flattened, shiny, mahogany-brown winged beetle from 2/5 in. to 4/5 in. in length. The eggs are probably deposited from August to October in shallow natural depressions or crevices on the exterior of the pole near the surface of the ground. Often the young larvæ enter the heartwood through knots. The young borers hatching therefrom eat out broad, shallow galleries running longitudinally in the sapwood and then enter the heartwood, the mines being gradually enlarged as the larvæ develop. As they proceed, the larvæ closely pack the fine excreted boring dust behind them. This débris, which is characteristic of their work, is reddish or dunnish yellow in color and has a clay-like consistency. The mines eventually end in a broad chamber, entrance to which is plugged up by the excelsior-like fibers of wood chiseled out by the strong mandibles of the larva. Here

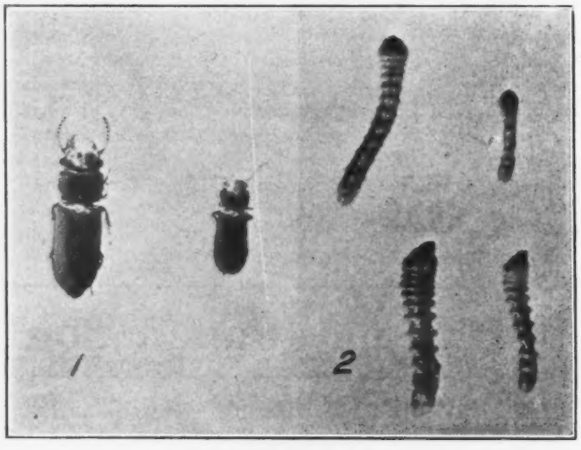


Fig. 1—Chestnut-Pole Borers; Male and Female Beetles and Larvae.

in the resting stage the pupa is formed, and in this chamber the perfect adult spends considerable time before emerging. The insect is very widely distributed, ranging from Ontario, Canada, to Texas, eastward to the Atlantic Coast and westward to Arizona and southern California. It is common throughout the natural range of the chestnut.

The injury to the poles consists in large mines in the wood near the line of contact of the pole with the ground, necessitating the frequent resetting or even replacement of the damaged poles. These irregular galleries of the grub run both horizontally and longitudinally throughout the heartwood and

Fig. 2—Damage to Untreated Chestnut Pole Near Ground.

are sometimes 7 in. long, but vary with the individuals, which show great differences in size. The borers usually work in the outer layers of the wood at the base of the pole for a distance of from 2 ft. or 3 ft. below, but sometimes from 1 ft. to 2 ft. above the line of contact of the pole with the surface of the ground. The greatest damage is to that area just below and just above the surface of the ground, where the conditions of air and moisture are most favorable. Often the entire butt up

to a distance of from 4 ft. to 6 ft. and higher, according to the depth of setting, is mined. The numerous galleries, often very close together, completely honeycomb the wood in a zone 3 in. to 4 in. in from the exterior of the poles, and this so weakens the poles that they break off close to the surface of the ground. Even if the damage is not serious enough to cause the poles to break off under strain, they are likely to come down during any storm and thus put the wire service out of commission. The beetle will attack poles that are perfectly sound, but evidently prefers to work where the wood shows signs of incipient decay. It will not work in wood that is soggy (wet rot) or in very "doty" (punky) wood. It has not yet been determined just how soon the borers usually enter the poles after they have been set in the ground, but poles that had been standing only four or five years contained larvæ and adults of this borer in the heartwood, and poles that had been set in the ground for only two years contained young larvæ in the outer layers of the wood. Poles that appear sound on the exterior may have the entire basal interior riddled; the work of the borers is not noticed until the poles break off. During August the young adults may be found in shallow depressions on the exterior of poles below the ground surface.

As more than one-fourth of the 3,500,000 round poles exceeding 20 ft. in length used annually by the telephone, telegraph and other electric companies are chestnut, and as this borer has seriously damaged as high as from 10 per cent to 40 per cent, varying with the conditions of site, of the chestnut poles which have been set in the ground for from ten years to twelve years in lines in the states above enumerated, it is evident that this insect is an important factor in decreasing the normal length of service of the poles. The damage is apparently greatest and the borers are most abundant where the poles are set in high or level dry ground under good conditions of drainage. Where the poles are in wet sites there is usually but little injury by wood-boring insects except to that portion near the surface of the ground. Conditions of drainage are more important than different soil combinations, and the condition of the soil is more important that its composition; that is, where the soil is hard-packed there is apparently less damage then where it is loose. The quality and condition of the poles before setting is a very important factor to consider before arriving at any conclusion as to the relative longevity of poles under various conditions of site.

It is not to be concluded that this wood-boring beetle is the only insect that injures standing chestnut poles. Indeed, the most common injury is by the wood lice or white ants. In lines from ten to twelve years old these insects have seriously damaged as high as 15 per cent of the poles, and their work is even present, at least superficially, in as high as 75 per cent of the poles under all conditions of site. However, the damage is usually to the outer layers of the wood, where it is moist and there is incipient decay and is more superficial and localized than that of the chestnut-pole borer.

Through the courtesy of the American Telephone & Telegraph Company and the Forest Service about forty chestnut poles set in a test line near Dover, N. J., were inspected to determine the relative merits of various methods of preventing damage by wood-boring insects to the bases of poles. In this line, less than eight years old, variously treated poles alternated with untreated poles in order that each chemical preservative and method of treatment might receive an absolutely fair test under the same conditions of site. The poles were 30 ft. long, 7 in. at the top and 33 in. in circumference 6 ft. from the base. In the inspection the earth was removed to a depth of about 1 ft. from the base of the pole and then the pole was chopped into to determine the rate of decay. This method of inspection for insect damage is not very satisfactory. The various methods experimented with in this test line were brush treatments with a patented carbolineum preservative and spiritine, charring the butt, setting the pole in sand and setting it in small broken stone. It was found that, although these methods may temporarily check the inroads of wood-boring insects, they will not keep the insects out of the poles. The most serious damage to the poles in this line was by white ants. Other insect damage was by a large black carpenter ant and the larvæ of a round-headed borer.

An inspection was made last September of the bases of over 400 chestnut poles set in a similar test line near Warren, Pa., and Falconer, N. Y. These poles were treated by the creosote open-tank method of impregnation and brush treatments of creosote, wood creosote, creolin, two different carbolineum preservatives and tar. They had been set in the ground for a period of five years. All of these treatments, except the brush treatments with creolin and tar, were efficient in preventing the attacks of wood-boring insects, and for at least a five-year period in this northern climate there was but little damage by insects to the poles in this test line. The most common injury to the untreated poles was by large black carpenter ants, which widen the longitudinal weathering checks and hence induce more rapid decay. The work of the chestnut-pole borer was found in several poles, but this beetle was evidently just beginning to attack these poles. There was some damage by a round-headed borer. No white ants or termites were present as the location was evidently too far north for these destructive borers. A report by inspectors of the American Telephone & Telegraph Company and the Forest Service on the remainder of the poles in this test line showed that these conclusions can be applied to all of the poles in the line, with the exception that there was superficial injury by small black ants to two poles treated by brush treatments of carbolineum avenarius and to two treated with wood creosote. Also, as the inspection progressed injury by the chestnut-pole borer became more abundant and serious, and the borers seemed to be established in the poles. Poles treated by the creosote open-tank method of impregnation and by brush treatments with creosote, and with "S. P. F." carbolineum remained uninjured.

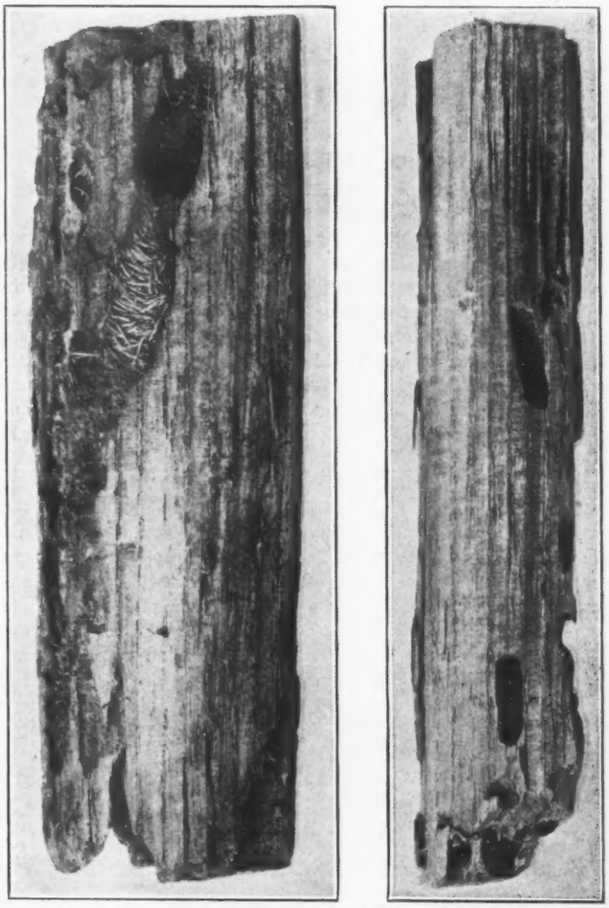


Fig. 3—Work of the Pole Borers.. At Left, Chamber Closed with Wood Fibers.

Methods of treating poles superficially by brushing with various preservatives have proved to be temporarily efficient in keeping out wood-boring insects if the work is thoroughly done and not only the butt but also the base is treated. When the base is left untreated the insects enter the pole from below ground. It is thus evident that impregnating the poles with creosote by some standard process, either the open-tank or the cylinder-pressure processes, will keep wood-boring insects out and preserve the poles for a much longer period than they would last untreated. In the open-tank method the area most subject to the attacks of wood-boring insects and deterioration in general, that is, the basal 8 ft., is treated, while by the cylinder-pressure processes the entire pole is impregnated. Alternating less susceptible juniper (red cedar) poles or pine poles, thoroughly impregnated by some standard process, in the line with the chestnut poles would be a safeguard in holding up an old line where the damage is found to be serious on resetting.

Letter to the Editor.

The Basis of Comparison of Illuminants.

To the Editor of Electrical World:

Sir:—The proper basis for comparing the efficiency of two illuminants, leaving aside such facts as cleanliness, divisability of units, color, heat, fumes, etc., is a subject of much importance since one frequently desires to ascertain the relative average performance of two different illuminants. There was a time when each maker would rate his illuminant in that particular candle-power unit which would indicate the highest candle-power value. Thus it was advantageous for the carbon-filament incandescent lamps to be rated in mean horizontal candle-power; Nernst lamps in mean lower hemispherical candle-power; upright gas lamps in upper hemispherical values, etc. This condition undoubtedly had something to do with the introduction of the term "lumen," which relates to the total light flux emanating from a source. Although the mean spherical candle-power unit, which bears to the lumen the numerical ratio of 4π to 1, was sufficiently definite, its possible confusion with other candle-power units made desirable the coining of the term "lumen." The lumen is also a more convenient unit when one is considering the light flux in a particular zone.

Of equal importance with the candle-power rating of lamps is the variation in the candle-power of the source during its useful life or its average candle-power in service. If the results of the careful tests of Dr. Louis Bell and Messrs. Preston S. Millar, J. R. Cravath, V. R. Lansing, Ward Harrison and other electrical men on gas lamps be accepted, the average performance of the gas mantle should be taken as from 60 per cent to 70 per cent of the initial laboratory value. The same condition seems to apply to the mercury-vapor tube lamps. Tests on tungsten lamps show that their average candle-power bears a high ratio to the initial, being about 95 per cent thereof. If the peak in the candle-power curves be included, the value reaches quite near unity.

Consideration should also be given to such factors as depreciation, interest on the capital invested, maintenance and renewals. Where the first cost of the installation is high, as in the case of the mercury-vapor tube lamp, the interest and depreciation become large factors. Another feature which is sometimes overlooked is that of considering for what particular purpose the illuminant is intended to be used. With some illuminants the eye can see detail better than with others. There are, therefore, two ways of comparing illuminants with each other.

On an illumination basis one illuminant may prove cheaper than another, while on an acuity basis the reverse may be true. The color of the illuminants may affect the acuity. A black letter on a white background would give a high acuity value for the mercury-vapor lamp, but a black letter on a red background would produce a lower acuity. The contrast effect which exists between an object and its background under a particular type of illumination may show up in favor of a particular illuminant.

One feature which is often overlooked in connection with gas lamps is the gas consumed by the pilot flames. It is stated that the pilot flames consumes only ⅛ cu. ft. per hour. If the main burner consumes 3⅓ cu. ft. and burns for three hours a day, the pilot flame burning twenty-four hours a day would consume about 30 per cent of the total gas used.

In considering two different illuminants one should determine, first, the mean spherical candle-power value under ideal laboratory conditions; second, the relation existing between laboratory conditions and the average performance throughout useful life; third, the total consumption, including that of auxiliary devices; fourth, interest, depreciation, maintenance and renewals.

Having decided to compare the illuminant upon either the foot-candle intensity basis or the acuity basis, and considering all of the other facts mentioned, one is in a position to determine the relative economy of one illuminant over another when used so as to produce equal average illumination for a given period of hours.

The above has been written in the hope that it will stimulate discussion, and that it will result in the publication of more definite information of a research character on the performance of various types of illuminants.

Harrison, N. J. Sydney W. Ashe.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Synchronous Single-Phase Machines.—F. Niethammer.—An article on some difficulties in the design of large 25-cycle, single-phase machines with reference to a recent investigation by M. Wengner, in which the armature reaction of the single-phase synchronous machine was emphasized especially as the chief feature distinguishing it from the polyphase machine. The present author gives a simple method for calculating a single-phase generator and especially the important damping (amortisseur) winding.—*Elek. u. Masch.* (Vienna), Jan. 22.

Alternators in Parallel.—J. W. Van Dyke.—For the investigation of the phenomenon of surging of alternators operating in parallel the author has devised an optical method for determining the angular displacement of the machines from their synchronous position. The results of tests made with this method are given in diagrams and tables.—*Elek. Zeit.*, Feb. 2.

Induction Motors.—W. E. Highfield and R. Livingstone.—A mathematical paper setting forth the considerations which affect the design of induction motors. The paper is divided into two parts, one being devoted to technical and the other to commercial considerations in order to show the relative importance of the two.—Lond. *Electrician*, Feb. 10.

Circular Diagram.—A. Thomaelen.—A brief paper illustrated by diagrams showing a simple method of deriving the Ossanna circular diagram from that of Heyland.—*Elek. Zeit.*, Feb. 9.

Lamps and Lighting.

Metallic-Filament Lamp.—A note on a recent British patent (11,107, Feb. 2, 1911) of O. Krause (Deutsche Gasglühlicht Ges., Auergesellschaft). It has been found that the lamp foot

containing the platinum leading-in wires is liable to burst when the binding materials of the tungsten filament are volatilized by raising it to a high temperature. To avoid this the leading-in wires are temporarily shunted by thicker wires outside the foot, or connection is made above the foot.—Lond. *Elec. Eng'ing,* Feb. 9.

Tungsten Lamp.—A note on a recent British patent (15,879, Feb. 2, 1911) of K. Schroeter. When filaments are drawn from a mixture of alloy of tungsten with a soft metal the latter is expelled by raising the filament to incandescence after it has been wound on the supports. A deposit of the volatilized metal may be formed on the supports, and, to make its removal easy, these are covered with a film of collodion, or wax, which is dissolved afterward in a solution and carries the deposit away with it.—Lond. *Elec. Eng'ing,* Feb. 9.

Generation, Transmission and Distribution.

Water-Power in Switzerland.—According to a statement recently issued by the Swiss Industrial Water Union a greater portion of the water-power now available in Switzerland is utilized than in any other country. The total water-power of that country is estimated at 1,200,000 hp, of which 400,000 hp was employed at the end of 1908, while 700,000 hp, or 60 per cent of the whole, will be in use for generating electrical energy early this year. The union intends to devote special attention to the question of government reservation of power for railways, while it will promote schemes for increasing the power economically available by the erection of storage reservoirs. Agitations against the taxing of electrical energy by the cantons will be set up, while a scheme showing the various prices charged for service will be prepared.—Lond. *Electrician,* Feb. 10.

Tendencies in the Design of Modern Power Plants.—G. W. MEYER.—The author gives instances from modern practice to discuss the following three tendencies in the design of electric power plants. First, the use of steadily increasing transmission voltages; second, the use of few generating sets of large rating; third, the operation of various plants in parallel to a common high-tension network.—*Elek. u. Masch.* (Vienna), Jan. 15.

Traction.

Three-Phase Freight Locomotive.—A description of a new design for three-phase locomotives, forty of which are now being constructed for use on the electrified main sections of the Italian state railways. There are five coupled driving axles and the two three-phase motors are mounted between the second and third and third and fourth axles. They are eight-pole motors, each rated at 1000 hp on the one-hour rating. Two running speeds of fourteen and twenty-eight miles per hour, obtained by cascade and parallel connections of the motors respectively, are provided for. The speeds of the motors in the two cases are 112.5 r.p.m. and 225 r.p.m. For accelerating water resistors are used.—Lond. *Elec. Eng'ing,* Feb. 9.

Installations, Systems and Appliances.

Static Substation Design.—P. V. HUNTER.—An illustrated paper read before the Newcastle Section of the (British) Institution of Electrical Engineers. After discussing general considerations, such as reserve plant and the effect of size on cost, the arrangement of apparatus in a substation where naturally cooled transformers are installed is described. Artificially cooled transformer substations are next considered and finally a discussion is given of a special type of station not coming entirely under either of the above heads.—Lond. *Electrician,* Feb. 10.

Ward Leonard Control.—A note on a recent British patent (10,370, Feb. 2, 1911) of E. C. Marks (Felton and Guilleaume-Lahmeyer Werke). In order to make the variation in speed of the motor exactly proportional to the regulation of the shunt field of the generator and independent of residual magnetism and the *IR* drop in resistances the generator is compound-wound and its shunt-field current is controlled automatically by an auxiliary generator coupled to the motor.—Lond. *Elec. Eng'ing,* Feb. 9.

Switchboard Construction.—W. FUHRMANN.—An article discussing various details of the design and construction of switchboards. He strongly recommends the greater use of recording instruments and also of frequency meters. He discusses some methods of mounting the instruments and switches and especially the correct mounting of the fuses.—*Elek. u. Masch.* (Vienna), Feb. 5.

Calculations of Starters.—F. NATALIS.—A description of a simple method for determining the different steps of the

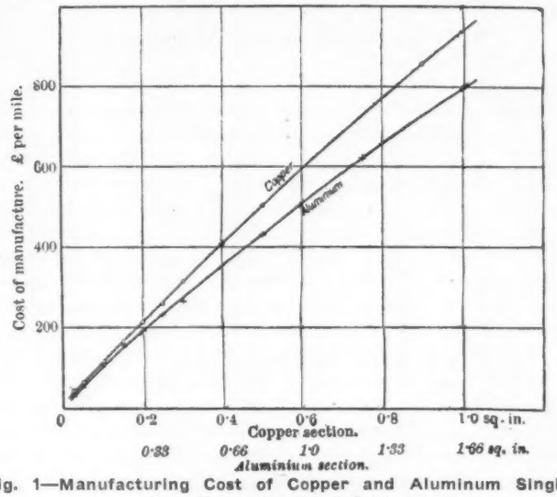


Fig. 1—Manufacturing Cost of Copper and Aluminum Single-Core Paper-Insulated Cables.

starters for direct-current, shunt and polyphase induction motors. The method is based on the use of logarithmic paper. *Elek. u. Masch.* (Vienna), Feb. 5.

Damping of Turbine Regulators.—KROENER.—The author discusses under what conditions a correctly designed reciprocating hydraulic regulator for turbines will oscillate for a considerable time before coming to rest and tries to determine in which cases an oil brake is to be recommended for getting rid of these oscillations.—*Elek. u. Masch.* (Vienna), Jan. 15.

Protective Devices for Electrical Apparatus.—A. G. HEATHER.—A paper read before the South African Institute of Electrical Engineers. The author confines his remarks mainly to alternating-current circuits. After discussing the features of fuses, he considers alternating-current relays, describing various types. Finally, the Cowan-Andrews and the Merz-Price systems are explained.—Lond. *Electrician,* Feb. 10.

Wires, Wiring and Conduits.

Aluminum Versus Copper Cables.—F. C. RAPHAEL AND J. B. SPARKS.—An article in which the authors compare the relative cost of copper and aluminum single-core, paper-insulated cables. The results of their estimate of manufacturing cost are given in Fig. 1. It is seen that for all sections aluminum cable is cheaper to manufacture than copper cable, and that for the larger sizes the difference is very considerable. The costs given are not those at which cable can be bought. They represent

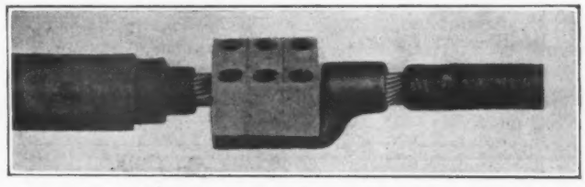


Fig. 2—Straight-Through Joint with Stepped Clamp on Aluminum Cable.

the bare manufacturing costs, including material, labor, etc., and no allowance is made for establishment charges, profit or transport and other general charges. Several methods of jointing are described. One of these is the straight-through joint of Fig. 2. A three-part stepped clamp is used on the aluminum cable, the clamping pieces being screwed onto the flat lug of a thimble into which the copper cable is sweated.—Lond. *Elec. Eng'ing,* Feb. 9.

Dielectric Losses in Insulators.—H. Jordan.—The first part of a paper giving the results of an investigation carried out in the German Telegraph Research Bureau on the measurement of dielectric losses in insulated fibers. After a theoretical introduction and a description of the method of measurements the author gives the results for cotton and paper cables and also deals with the absorption of water by these materials. The paper is to be concluded.—*Elek. Zeit.*, Feb. 9.

Electrophysics and Magnetism.

Origin of Magnetic Storms.—A. Schuster.—A note on a (British) Royal Society paper giving a critical examination of the theory that magnetic storms are caused by streams of electrified corpuscles ejected from the sun. If the electro-kinetic energy of such storms be calculated it is found that when the magnetic field produced is comparable with that observed in magnetic storms the energy is enormously great compared with that obtained by mere addition of the energies of the separate corpuscles. Even if during violent storms, when the magnetic force may be of the order 0.004 c.g.s. units, the corpuscles had an initial velocity nearly equal to that of light, the energy required to establish the magnetic field would be sufficient to reduce the speed to less than 4 km a second before the swarm reaches the earth, the passage between the sun and the earth taking about a year. In this calculation the cross-section of the swarm is assumed to be determined by the effective duration of the magnetic disturbances which it is supposed to produce. If the swarm be reduced in cross-section the energy belonging to it would be diminished, but for a given magnetic force the density of the corpuscles in the swarm must then be correspondingly greater. This leads to the consideration of the effects of electrostatic repulsion between the particles. It appears that if H be the magnetic effect the electrostatic acceleration at the edge of a swarm of electrons must be greater than $5 \times 10^{17}H$. This acceleration would be sufficient to drive a corpuscle in the first second through a distance equal to more than the diameter of the earth. It follows that, even taking account of electromagnetic attractions between the corpuscles, a swarm of corpuscles, when sent out from the sun in a definite direction, would soon be dissipated to such an extent that no sensible magnetic disturbance could be produced. Finally the electrostatic effects which could be observed on the surface of the earth in each magnetic storm are discussed, and here the calculation also leads to the conclusion that the theory criticised is untenable. If magnetic disturbances are produced by rays emanating from the sun it can, therefore, only be in an indirect manner. We may imagine that the injection of corpuscles ionizes the upper portions of the earth's atmosphere and consequently renders the already existing e.m.fs. more effective, or we may imagine the approach toward the earth's magnetic field of highly conducting material containing ions of both kinds acting as induction. The effect of such induction would primarily be an increase in the horizontal and a diminution in the vertical forces, while the currents induced in the earth, tending to diminish the horizontal forces, owing to their inertia would die out more slowly so that a semi-permanent effect would be left after the storm. This agrees with observation, but there are at present not enough data available to test the sufficiency of the explanation.—Lond. *Electrician*, Feb. 10.

Edison Effect.—M. Goly.—The author describes the well-known Edison effect in carbon-incandescent lamps and deals in general with the same effect as observed with other incandescent bodies. He gives a review of the various investigations which have been carried out with respect to this phenomenon and concludes that the theory of Richardson if not complete is at least approximately true.—*La Lumière Elec.*, Feb. 4.

Graphical Representation of Power.—L. Berger.—An article illustrated by diagrams giving a description of the new method of F. Punga (different from that of Steinmetz) for the representation of power and energy in alternating-current vector diagrams.—*La Lumière Elec.*, Feb. 4.

Electrochemistry and Batteries.

Determining the State of Charge of a Storage Battery.—In an article on instruments exhibited at the Brussels World's Fair a method is described for determining the charge of the plates in a storage battery by means of the arrangement shown in Fig. 3. A small portable voltmeter with a scale reading from —0.5 volt to +2.5 volts has as one terminal a flexible rope with a pure cadmium electrode at its end, which is inclosed in a perforated rubber cover. This cadmium electrode is inserted into the solution of the storage battery. The other terminal of the voltmeter makes direct contact with the plate, the condition of charge of which is to be terminated as shown in the illustration. When a battery has been discharged to 1.8 volts then the measurement of the potential difference between the positive plate and the cadmium electrode gives a reading of 2.05 volts, while the voltage difference between the negative plate and the cadmium electrode is 0.25 volt. The voltage of the cell is 2.05 — 0.25 = 1.80 volts. When the same test is made during charging the potential difference between cadmium and positive plate is 2.32, and that between the negative plate and the cadmium electrode is —0.18 volt (in the other direction). The e.m.f. of the cell is 2.32+0.18=2.5 volts.—*Elek. Zeit.*, Feb. 2.

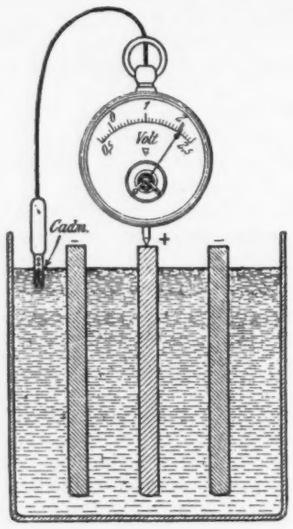


Fig. 3—Cadmium-Electrode Test of Storage-Cell Condition.

Units, Measurements and Instruments.

Clark and Weston Standard Cells.—H. L. Bronson and A. N. Shaw.—A British association paper in which the authors give the results of setting up Clark cells according to the specifications of Wolff and Waters. Certain modifications were also made in the preparation of materials. Good agreement was obtained with Clark cells at the Bureau of Standards, and somewhat better results with Weston cells. The importance of purity in the mercurous sulphate is emphasized. The ratio of the Weston to the Clark cell was determined and found to agree closely with that given by Wolff and Waters. The conclusion is reached that the Weston cell is much more satisfactory than the Clark cell. The authors state that their tests strongly support the claim of the Weston cell for adoption as one of the two legal electrical standards. The preparation of the cell for absolute work is far simpler than that of the coulometer, and it has the great advantage of being quite easily constructed if an accuracy of not more than 100 microvolts is desired. The cell is, to a certain extent, portable, and, if the mean of a batch of about ten is taken, there does not appear to be any chance for the uncertainty which was formerly associated with the standard cells.—Lond. *Electrician*, Feb. 10.

Demonstration of Phase Difference Between the Primary and Secondary Currents of a Transformer.—F. T. Trouton.—An

abstract of a (British) Physical Society paper. The apparatus is a primitive induction motor consisting of two horseshoe electromagnets with their axes coincident and vertical and their planes at right angles. Above the poles a copper disk is pivoted. The primary current from a transformer is sent through one magnet and the secondary current through the other. With a suitable phase difference a rotating magnetic field is thus obtained. The phase difference between the current is $\Theta = \frac{\pi}{2} + \tan^{-1}\frac{Lp}{R}$, L and R being the inductance and resistance of the secondary circuit. By increasing L, Θ tends to approach 180 deg., and consequently the torque acting on the disk becomes small. Increasing R makes Θ tend to approach 90 deg. and a larger rotation is obtained. Inserting an iron core into the transformer diminishes the speed of rotation owing to the increase of L and also to the fact that the hysteresis in the iron causes the secondary circuit to lag still more behind the primary. Lags greater than 180 deg. may be obtained when the rotation is in the opposite direction and may be reduced to nothing by increasing the resistance. A steel core will produce a greater negative rotation than an iron one. To demonstrate the hysteresis effect it is necessary that the core should consist of a bundle of fine wires, otherwise the eddy currents set up will introduce a lag. The effect of eddy currents can be shown by introducting another coil within the transformer in place of the iron core and closing its circuit with a variable resistance when lags larger or smaller than 180 deg. may be obtained according to the resistance. The hysteresis is greatly modified by subjecting the core to a permanent magnetic field by means of an additional coil on the transformer. Moderate fields increase the hysteresis, though large fields decrease it. This is due to working on the knee of the hysteresis curve in the first case, while in the second case the core is permanently saturated and acts as a non-magnetic substance.—Lond. *Electrician*, Feb. 10.

Ohmmeter.—In an article on instruments at the Brussels exhibition there is described an ohmmeter of French make which belongs to a general class of instruments in which two instruments are combined with the needles placed in such a way that they cross each other and that the position of the crossing point is the measurement of a quantity which can be mathematically derived from the two quantities given by the two instruments respectively. One instrument of this kind exhibited was a wattmeter, being a combination of a voltmeter and

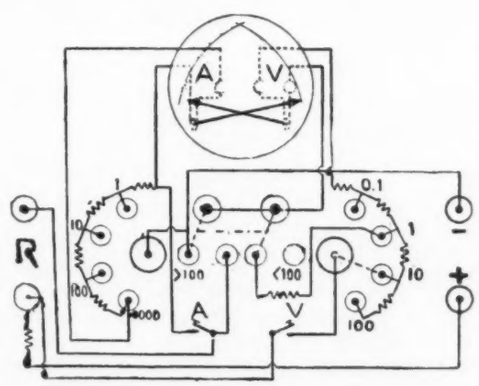


Fig. 4—Ohmmeter for Direct Measurement of Resistance.

an ammeter. Another instrument of this kind is a frequency meter, consisting of two hot-wire milliameters in parallel, one being in series with a non-inductive resistor and the other in series with a reactor. A third instrument of this kind is an ohmmeter, shown in Fig. 4, for measuring resistances from 0.1 megohm to 10 megohms. It is a combination of a voltmeter and an ammeter. The voltmeter measures the voltage drop in the resistor, the resistance of which is to be determined, while the ammeter measures the current passing through the resistor. The crossing point of the needle of the voltmeter and the ammeter gives directly the resistance in ohms. In order to neglect the errors due to power consumption of the voltmeter and the ammeter themselves two methods of connection are provided, as shown in Fig. 5. For determining high resistances the first arrangement, and for determining low resistances the second connection, are used. The very extended scale of this instrument and its independence of the voltage are special advantages.—*Elek. Zeit.*, Feb. 2.

High-Frequency Resistance of Wires.—J. A. FLEMING.—An abstract of a (British) Physical Society paper on the ex-

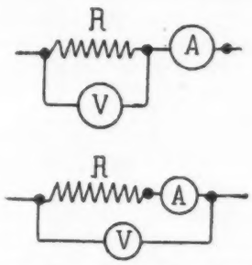


Fig. 5—Circuits for Eliminating Errors Due to Instruments.

perimental measurements of the high-frequency resistance of wires. The author uses an apparatus consisting of a differential air thermometer having tubular bulbs into which similar wires can be placed, and by means of which a comparison can be made of the high-frequency resistance R' of a straight wire and its steady or ohmic resistance R. If through one of two equal wires is passed the steady current A and through the other the high-frequency current A_1, then if these currents are adjusted until the rate of heat evolution in each case is the same, $A^2R = A_1^2R^1$. Certain precautions are described in the paper for eliminating inequalities, but by means of correct-reading high-frequency ammeters as devised by the author the ratio of the resistance R^1/R can be determined from the ratio of the mean square currents A^2/A_1^2. The high-frequency currents used were obtained by condenser discharges and the equi-heating steady current determined by means of the differential thermometer arrangement having two equal wires in the two tubular bulbs. It is then shown that the results for straight wires agree very well with the formulas given by Lord Kelvin and A. Russell for the ratio R'/R for wires of different sizes and for different frequency. It is pointed out that the correction to be applied for damped oscillations as compared with persistent oscillations is at most 1 per cent in the cases measured and that the correction for the heating effect of the condenser-charging current is negligible. The case of spiral wires is then discussed. The resistance R'' of a spiral is greater than that of the same wire R' stretched out straight. In the case examined the ratio R''/R exceeds R'/R by from 50 per cent to 80 per cent. Experiments are also described on the high-frequency resistance of wires of magnetic metals, and it is shown that in this case the observed value of R'/R can be used to determine the permeability for small high-frequency magnetizing forces.—Lond. *Electrician*, Feb. 10.

Exhibition of Instruments.—A. SCHWARTZ.—The first part of an illustrated description of the technical and scientific instruments exhibited at the World's Fair in Brussels in 1910.—*Elek. Zeit.*, Feb. 2.

Telegraphy, Telephony and Signals.

Simultaneous Telegraphy and Telephony.—K. FUCHS.—A long article describing briefly the different systems of simultaneous telegraphy and telephony. The author finally describes the methods employed on the Austrian telephone lines, in which all communications between customers and between the centr l and customers are by telephone, while communications between the different officials in different centrals are made simultaneously by telegraph.—*Elek. u. Masch.* (Vienna), Jan. 15, 22 and 29.

Conference of Telegraph and Telephone Engineers.—E. F. PETRITSCH.—The first part of a full account of the recent Paris

international conference of telegraph and telephone engineers, the proceedings of which have already been reviewed in the Digest.—*Elek. u. Masch.* (Vienna), Feb. 5.

Miscellaneous.

Magnetic Separation.—H. Hermanns.—An illustrated article on methods of magnetic separation for removing particles of iron from form sand, slags and other materials.—*Elek. u. Masch.* (Vienna), Jan. 29.

Patent Law of Holland.—A. Kuhn.—An article giving the principal features of the new patent law of Holland in comparison with the German patent law.—*Elek. Zeit.*, Feb. 9.

Testing Electrical Machines.—C. F. Guilbert.—A discussion of the differential methods of Kapp and Hutchinson for testing machines and of their recent modifications by Drysdale and Clinton, which were described in the Digest.—*La Lumière Elec.*, Jan. 2.

Syntony of a Quenched Spark.—W. H. Eccles and A. J. Makower.—A letter referring to a recent paper of Galletti and criticising his methods of calculating the efficiency of transference of energy from a primary circuit containing a quenched spark to an aerial as secondary. They suggest that the efficiency found by him is apparently too high.—Lond. *Electrician*, Feb. 3.

Wireless Telegraphy.—H. Poincaré.—A continuation of his highly mathematical paper in which he now takes up the predetermination of wave-length and damping coefficient of an exciter of given form.—*La Lumière Elec.*, Jan. 2.

Book Reviews.

Mechanical World Pocket Diary and Year Book. Manchester: Emmott & Company, Limited. 332 pages, illus. Price, 6d.

In the twenty-fourth annual issue of this useful handbook the contents have been increased by the addition of material on cutting tools and speeds; wheel gearing; annealing, hardening and tempering; details of gas-engine construction; steam-fitting, etc. The subject matter contains many reference tables and brief explanations of mechanical appliances, steam apparatus, etc. Blank diary and memoranda pages are included in the binding.

Elektro-Ingenieur Kalender for 1911. By A. H. Hirsch and Max Barth. Berlin: Oscar Coblentz. 322 pages. Price, 2.50 marks.

The 1911 edition of this little handbook, which the German-speaking electrical man may find more convenient to consult than the excellent manuals available in English, presents with characteristic completeness a mass of useful electrical information, reference tables, construction data, specifications, etc., but all generally of more theoretical than practical significance. As a reference volume it has a varied range of contents and also the scattered character to be expected in the space limitations of its pages. The book is specially bound for pocket use.

New Apparatus and Appliances

SNAP-SHELL INCANDESCENT-LAMP SOCKET.

The snap-shell incandescent-lamp socket made by the H. T. Paiste Company, Philadelphia, Pa., is illustrated herewith. On the shell are two heavy catches which slip into a formed channel running like a ring around the cap. The supporting edge of the channel where the catches grip is not flat, but is formed on an angle so that the ordinary strains and pulls on the shell only cause the catches to hold tighter. To guard against the shell turning in the cap both are locked together by two small lugs which enter the square recesses in the shell and prevent

Figs. 1 and 2—Snap-Shell Lamp Sockets.

it from twisting. By pressing the shell at the point marked on it and by a motion such as is employed in opening a book the cap and shell are readily disengaged. Sockets of this type are, of course, above all else time savers; the cap is first screwed to the fixture and secured by the set screw in usual manner and after the movement is wired the shell is inserted into the cap about 1/16 in. and then rotated to the position desired. A further push on the shell causes it to lock itself in that position.

ELECTRIC VEHICLES AT CLEVELAND AUTOMOBILE SHOW.

A very successful automobile show was held in the Central Armory, Cleveland, Ohio, during the week Feb. 18 to Feb. 25, inclusive. The building was tastefully festooned in green, with vari-colored lamps on all the pillars and at various other points. This, with the well-planned general lighting scheme and clusters of vines and flowers here and there, produced a very pleasing effect. Huge electroliers in novel shapes hung from the high ceiling in the main portion of the building, while the balconies were lined with smaller lamps. The arrangement of the displays brought out the good points of all the cars well. Displays of electric vehicles were made as follows:

Euclid Automobile Company, Columbus, electric coupé and four-passenger stanhope or open electric.

The Broc Electric Vehicle Company showed its new coupé and roadster. These vehicles are provided with silent-chain transmission, inclosed in dust-proof, oil-retaining cases. Exide batteries are used, but other types may be substituted.

The Cleveland branch of the Anderson Carriage Company, of Detroit, showed a gentleman's underslung roadster and a four-passenger extension brougham. These cars have a shaft drive operating in an adjustable bevel gear on the axle and without gear reduction. The roadster has a long wheelbase, is hung low and somewhat resembles a racing car.

The display of the Rauch & Lang Carriage Company, of Cleveland, consisted of a forty-cell, large extension four-passenger coupé and a small extension four-passenger, shaft-driven, twenty-four cell coupé, with chassis showing the chain cover and other strong points. All cars are provided with Exide battery standard equipment.

The Cleveland branch of the Hupp-Yeats Electric Car Company, of Detroit, showed one of its coupés. This car hangs low between the axles, with running board on a level with the floor. The motor is attached directly to the rear-axle gear housing and drives through bevel gears of Hecla steel. The batteries are carried over the front axle and concealed by the hood. The absence of reduction gears does away with the

usual strain of a shaft, it is claimed, and makes a very satisfactory operation.

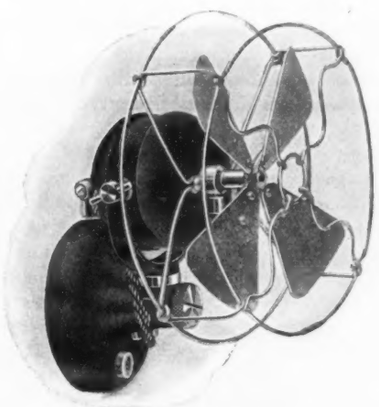
The Baker Motor Vehicle Company had on display an extension four-passenger coupé, a special extension four-passenger coupé, a Queen Victoria and a chassis, showing the working parts of all its cars. This company has adopted the shaft-drive exclusively, with bevel-gear transmission.

The Studebaker Automobile Company showed a single electric car, a four-passenger, single-chain inclosed, with full floating-type rear axle and twenty-cell, eleven-plate Exide standard equipment. The interior was finished in whipcord and the car was provided with a full equipment of accessories for the use of ladies. Westinghouse motor and controller are used in the car.

Mr. J. H. Greenwald displayed a four-passenger Waverley of the latest-design coupé body.

CARLETON DESK FAN.

The Carleton Company, of Boston, Mass., has brought out a 6-in. fan for standard direct-current and alternating-current circuits and also wound for 7-volt battery circuits. While the fan is primarily intended for desk use, by means of an ingenious device it is readily convertible to a bracket fan, and this with the trunnion suspension permits adjustment at any desired angle. The bearings of the fan are of bronze and are of ample size. The oil cups are large and the commutator is



Six-Inch Bracket Fan.

built up with mica insulating strips punched to shape and held rigidly in place under pressure. The brushes are of carbon with a core of copper. The fan is finished in black and the bright parts are finished in copper or are nickeled. The manufacturer claims that the fan is suitable for use where a ceiling fan is not required and is well adapted for general home and office use. It is said to be almost noiseless in operation and to deliver a breeze surprisingly large for so small a fan.

FURNACE CEMENT THAT WILL RESIST 3000 DEG. FAHR.

Engineers have experienced difficulty in the proper maintenance of brick settings of furnaces of all types, having had to depend very largely upon the ordinary fireclay as a bonding material. As this fuses at a comparatively low temperature, the bond between the bricks is rapidly destroyed, with the result that cracks are opened up between the bricks through which the gases of combustion enter, eventually weakening the brick and causing the walls to collapse.

Another objectionable point of settings has been that refractory bricks become porous on the surface and very soon the clinkers from the coals attach to the surface of the brick, and in removing these with tools the bricks are broken.

After several years devoted to research work on refractory cements to overcome these troubles the H. W. Johns-Manville Company, New York, has developed a line of cements called "J-M Refractory Cements" for furnace setting of various types, cupolas, lining brass furnaces, assayers, crucibles, oil-burning, tilting and rotary furnaces, and for patching and facing bricks in place in the fire zone under various conditions.

These cements resist temperatures as high as 3000 deg. Fahr. The same company has also developed a coating for walls known as "J-M Brickline Cement," which seals the pores of the brick and prevents clinkers from adhering.

REDUCED ENERGY CONSUMPTION OF AN EIGHTEEN-HOUR ICE-MAKING PROCESS.

Of special interest to central stations desiring to increase their plant incomes are the operating results recently obtained with a new ice-making process first described in the *Electrical World*, Nov. 21, 1908, the notable features of which are eighteen-hour ice manufacture at an energy consumption less than one-half that of other systems. The installation of such ice-making equipment provides a profitable and controllable load which fits the "hollow" of the central-station daily load curve; produces an increased quantity of ice for the same energy expenditure; makes use of raw water, avoiding the necessity of distilled water, part of which must be made up in the average plant by the condensation of live steam; and requires a minimum of ice-making equipment and investment, since the entire tank capacity produces its rated amount of ice every twenty-four hours.

By the center-freezing process the freezing is done about "grids" or combs of 1-in. tinned pipes, suspended in the freezing tanks and traversed by brine circulation at a temperature of 15 deg. to 20 deg. below zero, Fahrenheit. From each pipe as a center the formation of ice proceeds in all directions, the effects of adjacent pipes (at 5-in. intervals) combining to produce solid plates 20 ft. x 14 ft. in size and 11 in. thick, with the pipe grid as a core. To produce such an 11-in. cake it is obvious that the extracted heat has to be withdrawn through only 5 in. of ice thickness, instead of the entire 11 in. as in the plate process. Ice is a poor thermal conductor and the lessened distance of heat travel by the center-freezing process is chiefly responsible for the higher rate of ice production obtained. Again, as the pendent pipes carrying the brine are entirely inclosed in the water to be frozen the losses are a minimum, accounting for the high tank efficiency secured. Raw water is used as the ice-making material, being agitated by air blown from the bottom of the tank. Due to the centrifugal freezing action, all impurities are pushed ahead and to the outside of the forming ice cake, leaving the ice itself as solid and pure as that frozen naturally under perfect conditions. After ice of the desired thickness has been reached the grid is raised, carried to the harvesting device, and warm brine passed through the pipes, releasing them from the ice, which is then cut up into cakes of the proper size. The series of small holes left in the ice thus frozen are not found to impair its storage qualities, or to be objectionable to customers. They serve as a virtual trademark, distinguishing this process from any other. The holes may be filled with water and frozen closed if desired.

After thorough tests made by Mr. Edward N. Friedmann, president of the American Society of Refrigerating Engineers, acting as consulting engineer for the purchasers of the patents, Mr. Friedmann concluded as follows:

"The Centerfreze system has been shown in the tests above described to be an absolute success, and taking into consideration that in test No. 2 12 in. of commercial ice was made in twenty-one hours makes it certain that this system has a great commercial future."

Tests on a thirty-ton absorption plant on Long Island, using this system, were made by engineers acting for the Centerfreze Ice Process Company, the results of which further indicated a great improvement in the efficiency of ice manufacture. Interested parties wishing to satisfy themselves in their own way employed Messrs. L. B. Stillwell and Herbert S. Putnam, consulting engineers, New York, for the purpose of confirming the reports of the Centerfreze Company's engineers, which showed 14.9 tons of ice per ton of coal. In the report of these tests, covering both twenty-four-hour and forty-eight-hour ice-making cycles, Mr. Stillwell and Mr. Putnam conclude as follows: "Further, we find by calculation that if the forecooler were operated in the manner above suggested . . . [the plant] efficiency would approximate 92 per cent and the production of ice would be further increased . . . to 15.74 tons per ton of coal burned."

To quote further from Mr. Stillwell's and Mr. Putnam's report: "As compared with competing processes the Centerfreze process requires materially less ground space, smaller buildings and less refrigerating equipment. These differences imply a material reduction in first cost. The ice produced is clear and of excellent quality, superior to that produced by the can process and equal in quality to plate ice. In our opinion the holes left in the cakes are not materially objectionable as increasing the exposed melting surface, and we think they should not reduce the market value of the ice. The grids afford very convenient means of lifting the ice cake from the freezing tank and carrying it to the harvesting table. . . ."

In June, 1910, an exhaustive test of the 200-ton absorption type Centerfreze ice-making plant at Oklahoma City, Okla., was made under the supervision of Dr. Edwin DeBarr, of the University of Oklahoma, who was employed by the Oklahoma City company to determine whether the plant's efficiency fulfilled the guarantee made by the Centerfreze Company of fourteen tons of ice per ton of coal; E. E. Gainer, of New York City, representing the Centerfreze Company, and H. W. Garlington, of Louisville, Ky., representing the Henry Vogt Machine Company, which furnished the refrigerating machinery. Oil having a calorific value of 19,864 b.t.u. per pound was used as fuel. As a result of the sixty-hour test 279.17 tons of ice were made at the expenditure of 21,835 lb. of oil, or 433,730,440 b.t.u. This, it is seen, is equivalent to producing eighteen tons of ice per ton of coal having a fuel value of

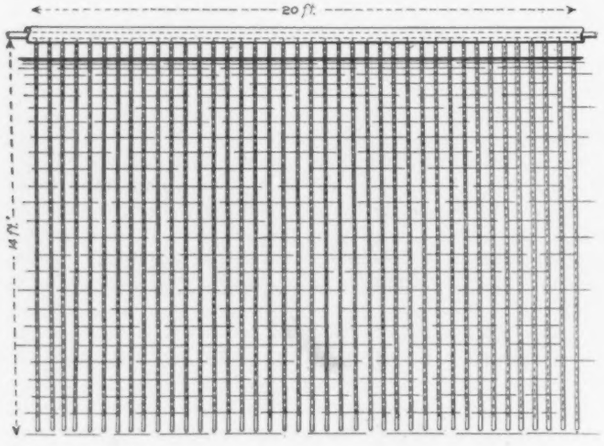


Fig. 1—Centerfreze Grid of Brine-Carrying Pipes Immersed in Freezing Tank.

14,000 b.t.u. per pound. The extraordinary significance of this figure will be realized when it is recalled that the practical ice-making output of the average ice plant is about five tons of ice per ton of coal.

In the Oklahoma City plant, during the forty-eight-hour test, the brine entered the grids at an average temperature of 9.07 deg. Fahr. above zero and left at 11.36 deg. The condensing-water temperature obtainable was unusually high, far above that for which the plant was designed. Entering the cooler at 88.33 deg. Fahr., this water was heated to 104 deg., the average temperature of the outside air meanwhile being 84.6 deg. The tank temperature at the beginning of the freeze was 62.8 deg. The steam boiler pressure used was 126.3 lb. per square inch, generating in the ammonia system a pressure of 218.5 lb. per square inch. An average expenditure of 11.6 kw was required to supply the agitating air pressure at 43 lb. per square inch.

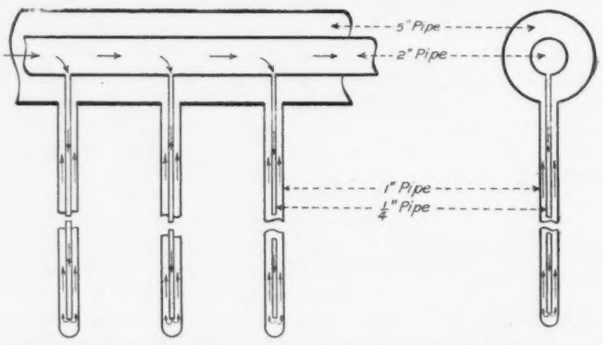


Fig. 2—Sections of Grid and Pendent Pipes, Showing Brine Circulation.

This agitation outlay, enabling raw water to be used, amounted to about 2.5 kw-hours for each ton of ice produced. During the Oklahoma tests, notwithstanding the high temperature of the cooling water, the investigators were nevertheless enabled to make 11.25 in. of ice in one tank in twenty-four hours and 10.25 in. in another tank in twenty-one hours.

Where the central-station equipment is of the less efficient non-condensing type it will in general be found advisable to install absorption apparatus to take the fullest advantage of the heat-energy contents of the steam. Where the steam-using apparatus, however, is of modern, highly efficient, compound condensing type, the generating machinery being loaded during only a few hours of the day, the compression system, using motor-driven compressors, may then be found most advantageous, the eighteen-hour period of the Centerfreze process enabling its demand to be kept clear of the lighting peak of the station. In either case the use of sweet or undistilled water in Centerfreze ice-making avoids the expensive condensation of live steam for augmenting the supply of distilled water obtained from the plant exhausts.

The preceding figures, which are taken from duly substantiated reports of actual tests by engineers of high standing, indicate that the novel center-freezing principle of operation employed by the system described promises some remarkable results for central-station as well as other ice-making plants. Combination ice and electric plants, even using the older can and plate systems, have proven extremely profitable, as is shown on other pages of this issue. Office and engine-room

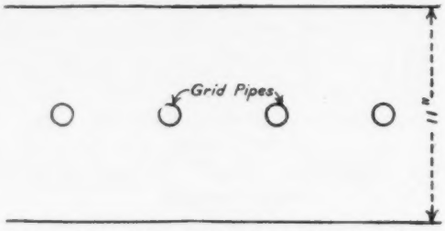


Fig. 3—Horizontal Section Through Centerfreze Ice, Showing Holes Left by Grid Pipes.

forces do double duty and a single set of fixed costs is substituted for the separate expenses of purely ice or electrical plants. With the system just described it would seem, however, that the central station is better equipped than ever before to enter the field of profitable ice manufacture. The Centerfreze Ice Process Company, 17 Battery Place, New York, is the owner of the patents covering the Centerfreze system of ice making.

AN OLD-TIME CENTRAL STATION.

Those who believe that the proper place for out-of-date machinery is the scrap pile will find their prejudice challenged by the experience of some of the smaller central stations which are yet operating successfully with what some modern manufacturers may consider archaic equipments which should have been scrapped long ago. Still more of a shock is it to discover that these same old types are still giving satisfaction.

The municipal electric plant at Oxford, Ohio, is an example

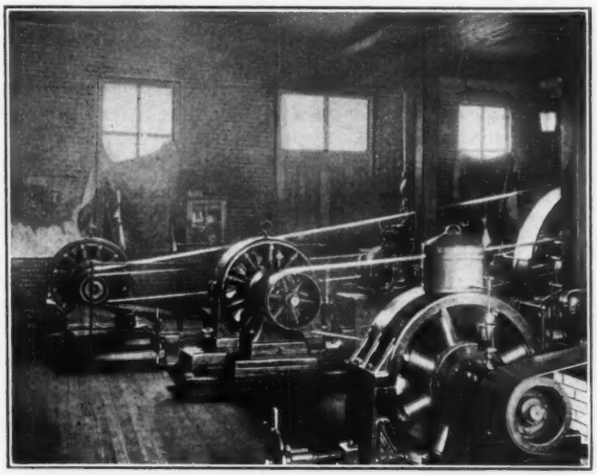


Fig. 1—Belted Alternators at Oxford, Ohio, Installed in 1889.

in point, since it is operating a plant installed twenty-two years ago, with, it is claimed, a maintenance charge as low as that on modern apparatus.

This entire plant, including generating apparatus, station equipment, power house and lines, was installed by the Westinghouse Electric Company in 1889. Since that time it has been operating regularly and from present indications will continue to do so for a good many years. Part of the original generating equipment still in use consists of two duplicate units, each a Westinghouse 500-lamp, 1000-volt, 133-cycle, 2000-r.p.m.

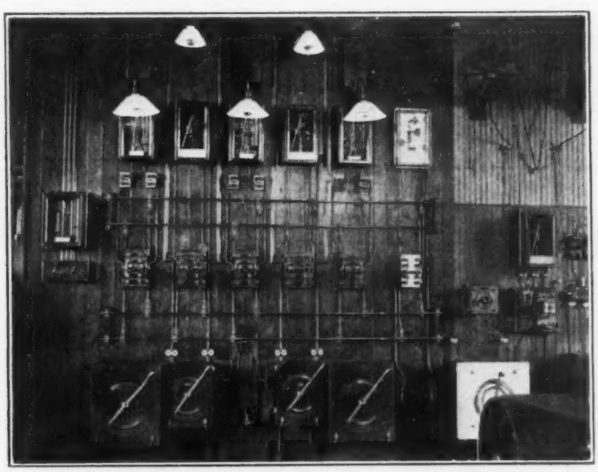


Fig. 2—Old Wooden Switchboard in Oxford Station.

generator driven by a vertical automatic 350-r.p.m. engine. The revolving armatures have been rewound, but the field coils, except one or two, remain as originally installed. The original oil cups have been supplemented by a reservoir on the top of each generator feeding by gravity. One of the engines has its original cylinder and has never been rebored. The other engine had a new cylinder shortly after installation.

There is also a Westinghouse series arc generator, installed in 1889, running at 750 r.p.m. The operators of the plant state that this generator operated for fifteen years without one cent of repairs. At the end of that period the original brushes were still in use and the bearings had not required rebabbitting. This machine was originally wound for 9.5 amp, but in 1905 was changed for 6.6-amp lamps. This generator was rated at forty lamps, but has been regularly carrying forty-five lamps.

In 1900 the equipment was increased by the addition of a 60-kw, 1100-volt, single-phase generator, driven by a 100-hp, 180-r.p.m. Buckeye engine, which also drives the arc generator.

The switchboard is archaic according to modern notions, but efficient and serviceable. The wiring and connections are of the old surface type on wooden backing, with the switches mounted on wood bases. The meters, too, have wood cases and are of the Westinghouse-Lange type with compensators. The coils of some of these meters have been open-circuited in several cases by lightning, but have been reconnected by the attendant. A portable voltmeter of modern design is kept at the station for checking the feeder voltmeters. As the photograph shows, the switchboard wiring was done in an exceptionally neat manner.

No doubt a large measure of the success of the machinery is due to the care taken in operating it. Nevertheless, this and other old-time plants like it show that machinery is not necessarily worthless because it is old.

ELECTRIC ROCK DRILL.

The electric rock drill built by the Fort Wayne Electric Works, Fort Wayne, Ind., is the result of several years' development and testing under the severe and unfavorable conditions of actual working operations. Contrasted with designs making use of flexible shafts, solenoids, springs, etc., the Fort Wayne drill is simple, rugged and effective. The drill is of the rotary hammer type, operated by an electric motor mounted on the frame of the drill proper. The mechanism of the drill comprises a revolving helve containing the hammers and a chuck mechanism for holding and rotating the drill steel. An idler is arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus the advantages of hand drilling are obtained without the disadvantages usually incident to machine drilling. The drill steel is held in the chuck by means of several spring steel plates and when not striking rock the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground. The drill casing, striking mechan-

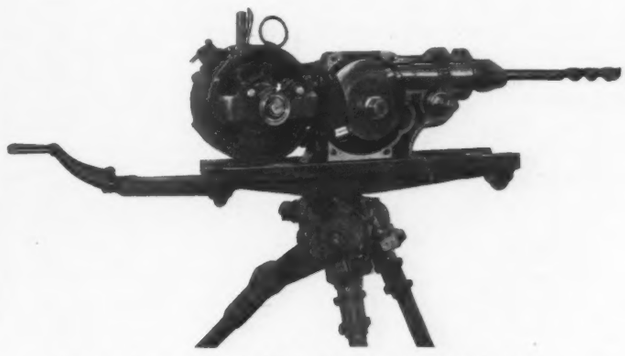


Fig. 1—Electric Rock Drill, Showing Revolving Helve.

ism, chuck and buffer plates are simple and substantial. The floating hammers in the helve are of special steel and are cushioned by air chambers so that the jar of the impacts is reduced to a minimum. The drill steel cannot be jammed into a fissure or cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge it has hammered for itself a square shoulder or face,

due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring. Another point of merit in the drill is the method employed for the removal of cuttings from the hole being drilled. A specially designed steel removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the item of pressure systems, including tanks, hose, water lines, etc., is eliminated, to say nothing of the cost of maintenance and the inconvenience incident to such systems. While the drills are ordinarily used in a horizontal position they can be used in any position and will drill holes at any angle. The ease with which energy can be transmitted throughout the workings by wire and the rapidity with which the lines can be changed enable the operator to advance his work more rapidly than could be done when using other types of drills. It is claimed that the electric drill described requires about 1½ hp to 2 hp, including transmission loss, while an average air drill requires from 12 hp to 18 hp for the same work. This is attributed to the design of the drill, the greater efficiency of the electric motor and the small loss in transmitting power to the drill. The simplicity and ruggedness of the design presage low cost of maintenance.

Fig. 2—Electric Rock Drill with Case Closed.

The drill can be operated with either an alternating-current or a direct-current motor, and since the motor is entirely independent of the drill the change from one to the other is easily made.

ELECTRIC VEHICLE ECONOMY.

The following case illustrates a common but too little appreciated electric vehicle problem: On April 25, 1910, the Balbach Smelting & Refining Company, of Newark, N. J., installed a 44-cell, 25-plate Gould storage battery in its old 5-ton electric. Up to the middle of February, 1911, when the inspector of the Gould Company visited the garage, this battery had run every day except Saturdays and holidays without a single cleaning, repair or plate renewal. The inspector found that the sediment in the jars was only within ⅝ in. of the top of the bridges, but a cleaning was recommended as a general precaution. The Balbach people, however, stated that they could not spare the vehicle from service for that purpose and ordered an extra tray of cells to permit the cleaning of the battery at leisure, a tray at a time, thus giving a tray ready at all times for emergencies.

The incident suggests that in every case where a vehicle owner does not have one or more reserve batteries beyond the full number required by his vehicles he should obtain at least an extra tray of cells for the following reasons: 1. It permits thorough cleaning of the batteries at stated intervals, a tray at a time, with no delays or interference with service. 2. It permits the regular and frequent equalization of acid density and testing to be done during the days, instead of making a rush job of the work at night. 3. It is a cheap form of service insurance, providing a reserve at all times in case of failure of a cell or tray from any cause. 4. It promotes the proper maintenance and care of batteries, which are factors of inestimable importance in prolonged battery life.

It is advisable that there be an extra tray for at least every two batteries in service. When it is possible to employ duplicate storage batteries, so that they may be exchanged at the main garage or convenient substation about the middle of the day's work, a fresh battery replacing that discharged by the morning's work, the electric vehicle immediately becomes a competitor of the gasoline truck for long-distance delivery and transfer work—a service which it will perform with much greater reliability and considerably less cost than the latter. Or, viewed from another standpoint, the relatively small increase in the investment of a duplicate battery doubles the earning capacity of the vehicle, which represents by far the greater proportion of the total investment. While all service conditions do not permit the use of duplicate batteries, where they can be used great economy results.

TWIN-GLOWER ELECTRIC RADIATOR.

Until it becomes customary to include special heating circuits in the wiring of our homes the most successful heating devices will be those which are readily attachable to the lighting circuit in place of a lamp. In the twin-glower electric radiator recently developed by the General Electric Company the feature of ready applicability appears to have had first consideration in that the heating elements are designed for a maximum energy consumption of 500 watts, thus permitting the operation of the radiator on any lighting circuit.

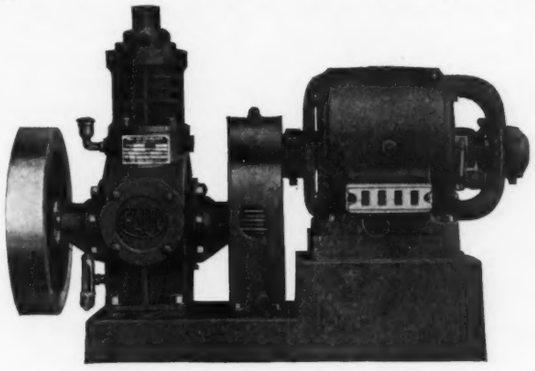
Extreme lightness of weight permits of the radiator being easily moved from room to room or to any other desired place. Thus it can be readily used for increasing the temperature of the bathroom preparatory to the bath, for making the bedroom comfortable in the early morning when the regular heating system has a low tone, and for adding to the comfort of reception halls, libraries, studies and other rooms which usually are of temporary occupancy. Furthermore, the absence of carbonic-acid-producing open flames renders its use particularly desirable in rooms containing valuable paintings and beautifully bound books, which rapidly deteriorate when exposed to injurious burnt gases or products of combustion.

The price of the twin-glower electric radiator is only about a third more than that of the popular 6-lb. electric flatiron, and its cost of operation is about 5 cents an hour at the usual central-station charge for energy. It is, therefore, within the reach of all who desire to avail themselves of many comforts which are unobtainable economically by any other means. Since these devices are used only for fractional parts of an hour the monthly expense is comparatively small.

Twin-Glower Electric Radiator.

ELECTRIC VACUUM PUMP.

The vacuum pump illustrated is a single-cylinder machine direct-geared to an electric motor. It is of the "Paul" type made by the Fort Wayne Engineering & Manufacturing Company, of Fort Wayne, Ind., and is substantially the same



Single-Cylinder Direct-Geared Vacuum Pump.

machine as the air compressors made by the same company. The efficiency is given by the manufacturer as from 90 per cent to 95 per cent. This makes these compact sets well adapted for vacuum drying and evaporating processes, as well as for use in connection with heating systems. In vacuum systems of steam heating it is intended to maintain a certain degree of vacuum or a pressure of steam below that of the atmosphere in the boiler and radiators. This may be accomplished by connecting the automatic air valves of the system to a common air line in which a sufficient vacuum is maintained by a vacuum pump. Electric drive is well adapted for the operation of this pump, as the machine may be controlled by an automatic switch, making the consumption of energy very economical, it being in proportion to the work done. The size of the vacuum pump for a heating system depends on the amount of radiating surface and the tightness of fittings. One rule is to allow 50 cu. ft. of displacement per hour of pump operation for every 1000 sq. ft. of radiating surface. The ordinary commercial sizes of pumps are driven by motors rated at from 0.25 hp to 2 hp.

AN ELECTRICALLY OPERATED GAS METER.

A useful laboratory method for measuring the passage of a quantity of gas of any kind is to insert an electric heating coil in the pipe, measuring the temperatures of the stream of gas before and after passing the heater. Knowing the specific heat of the gas—that is, the heat necessary to raise 1 cu. ft. of it 1 deg. in temperature—and having measured the electrical energy converted into heat by the coil, the volume of gas passed can easily be computed. Again, if with the same arrangement we vary the current flowing in the heater so that the difference in temperature shown by the two thermometers remains constant, the electrical energy taken by the heater and measured by a watt-hour meter will be exactly proportional to the gas which has passed.

A practical meter designed for measuring the flow in large gas mains which accomplishes automatically the regulation of the heating current to keep the temperature difference of the two thermometers constant at 2 deg. Fahr. is the invention of Prof. C. G. Thomas, of the University of Wisconsin. The stationary measuring element, Fig. 1, which is inserted in the main pipe carrying the gas or air to be measured contains an electrical heating coil *B*, and on each side of the heater are two screens of fine resistance wire *EE* having the function of thermometers, arranged as the arms of a Wheatstone bridge. Variations in the temperature difference between these two screens cause deflections in a galvanometer needle, making contacts to close magnetic clutches and by means of a motor-driven ratchet wheel and rheostat increasing or diminishing the energy flowing into the heater. The recording watt-hour meter which measures this energy input into the heater is calibrated to read directly in cubic feet of gas. The electrical energy to operate the meter is approximately 1 kw per 75,000 cu. ft. of illuminating gas, with the screens set for 2 deg. Fahr. difference in temperature. This figure varies, of course, for different gases measured.

The principle of the meter thus enables it to measure gas or air at any temperature and at any pressure, its accuracy not being affected by fluctuations of either, since in heating gas

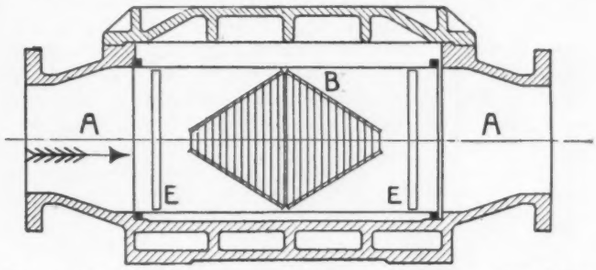


Fig. 1—Heater and Thermometer Element of Thomas Gas Meter.

or air the temperature rise depends upon the mass of the gas, not its volume. Whether 1 lb. of air occupies 10 cu. ft. or is expanded to 100 cu. ft. the amount of electrical energy taken to raise its temperature 2 deg. is identical, and whether the gas is moving rapidly or slowly through the meter exactly the same amount of energy will be required. If the gas enters the meter at 60 deg. its temperature will be raised to 62 deg. If it enters at 100 deg. Fahr. its temperature will be raised to 102 deg., so that, as stated above, neither temperature nor

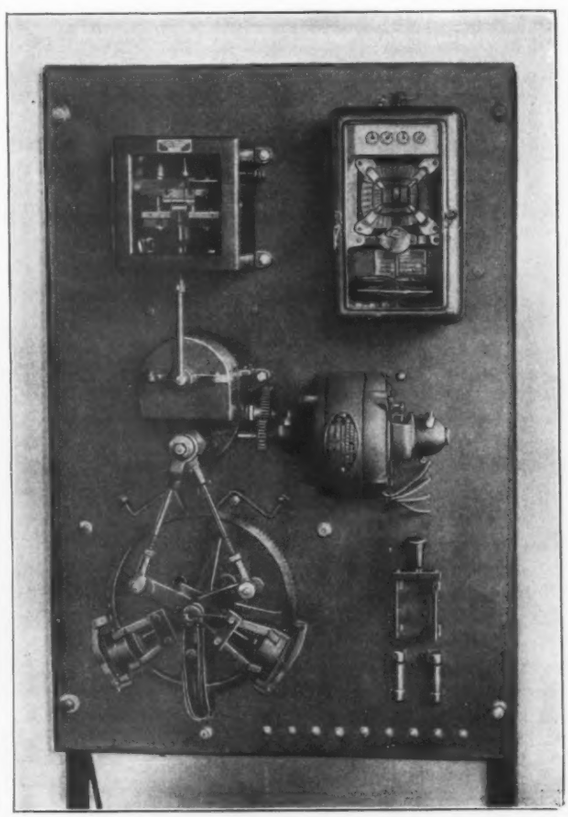


Fig. 2—Switchboard and Recording Mechanism of Thomas Electric Gas Meter.

pressure has any effect on the accuracy of the meter's measurements.

The important features of the meter are: There are no moving parts inside the gas main. This meter measures weight

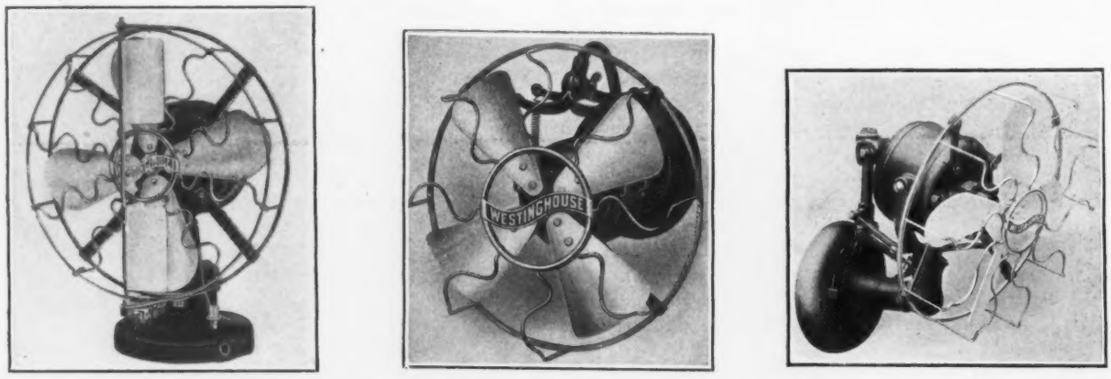
or mass of gas instead of volume as do other meters, and will read directly in standard cubic feet regardless of temperature or pressure, its operation being independent of temperature or pressure and of fluctuations in either. Meters of very large capacity occupy but little space, and since the parts are connected electrically they can be located at any distance from each other. The recording mechanism, for instance, may be placed in the general offices of a gas company, which may be a mile or more from the gas works.

The principal applications of the Thomas meter are measuring illuminating gas, natural gas, blast-furnace gas, compressed air, air flow in ventilating or forced-draft systems, etc. Since in the operation of the meter about 1 kw-hour is consumed for the passage of each 75,000 cu. ft. of gas the device becomes a desirable load for the central-station company to have on its lines. The consumption is largely long-hour business, while, due to the superior inherent characteristics of this meter, it is applicable to a large number of other uses besides the eminently satisfactory one of making a central-station customer of the competing gas company.

The Thomas meter is manufactured by the Cutler-Hammer Company, Milwaukee.

WESTINGHOUSE FANS FOR 1911.

The 1911 line of fans of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., includes all of the types furnished in 1910 with the addition of several designs. The line built by this company now includes alternating-current and direct-curent fans for all purposes; desk and bracket fan motors of the swivel-and-trunnion, mechanically operated oscillating and air-operated oscillating types with 12-in. and 16-in. blades; 12-in. six-blade residence-type fan motors; 8-in. desk and bracket fan motors; 8-in. telephone-booth fan motors; a complete assortment of ceiling, counter, column and floor-column fans, and 12-in. and 16-in. exhaust fans with either Westinghouse standard or Blackman blades. The alternating-current fans are designed for 25 cycles, 30 cycles, 40 cycles, 50 cycles, 60 cycles and 133 cycles, 110 volts or 220 volts; the direct-current fans are designed for 30 volts, 50 volts, 110 volts or 220 volts, except the ceiling and column types, which are not built for the battery voltages. With the exception of the 8-in. fans the alternating-current motors are of the induction type starting on the split-phase principle. In the desk and bracket types the starting winding is automatically cut out by means of a switch when the motor attains speed. The direct-current motors and the 8-in. alternating-current motors are designed for high efficiency and sparkless commutation. The armature cores are built of laminated steel with the coils inclosed in slots, and the well-designed commutators and rectangular brushes cut down operating troubles. Most of the fans are lubricated by grease cups feeding through wicks, and the ceiling fans have in addition ball bearings. The 12-in. and 16-in. desk and bracket swivel-and-trunnion fans are adjustable through a wide angle and are clamped firmly in any position. An adapter is furnished for bracket use, which can be inserted between the motor body and the base without opening the circuit. The 12-in. and 16-in. mechanically operated oscillating fans are additions to the Westinghouse line. The fan is of the same construction as the swivel-and-trunnion type, having a wide adjustment above and below the horizontal. The oscillator mechanism consists of a double worm reduction and a single oscillating lever. The gears are inclosed in a case packed with grease. The arc of oscillation is adjustable within 90 deg. These fans can be quickly arranged for wall mounting by means of an adapter similar to that used with the swivel-and-trunnion fans. Air-operated oscillating fan motors are still furnished in 12-in. and 16-in. sizes for use where oscillation in the horizontal plane is sufficient. The angle of oscillation is adjustable by means of movable stops in 30-deg. steps. If desired the stops can be removed and the fan allowed to revolve continuously. The use of contact rings to conduct the energy to the motor makes this possible. A substantial bracket is furnished for wall mounting. The Westinghouse 12-in. residence fans are particularly applicable for hospitals, libraries, sleeping-rooms or other places where quiet is essential. The fans operate at low speed, but have six blades set at a high pitch instead of four. Otherwise they are the same as the desk and bracket types. The 8-in. desk and bracket fans have become very popular for use where the strong breeze of a large fan is undesirable. The bodies and bases of these motors are of pressed sheet metal, finished in black oxide, mottled copper, polished brass or brushed brass. The 60-cycle, 110-volt motors of this type can be used with a special converting base on 25 cycles to 50 cycles or on direct current of the same voltage. A swivel arrangement in the base makes it possible to mount the fan either in a vertical position or on the wall and makes vertical angular adjustment possible. The 8-in. telephone booth fan is identical with the 8-in. desk and bracket type, except that the motor body is suspended from a bracket by four springs, which prevent vibrations being transmitted to the telephone. The ceiling and column fans for alternating-current circuits are built with 56-in. blade sweep, one-speed fans finished in black japan and three-speed fans finished in mottled copper. The direct-current fans are built in 32-in., 54-in. and 57-in. sizes, with various finishes. Ceiling fans and column fans are identical except for the method of mounting. The counter-column fan motors have 36-in. to 48-in. clearance between blades and base, and floor-column fans about 7 ft. All of these fans have substantial blades of hard wood with mahogany finish. An addition to the Westinghouse line is a design of 12-in. and 16-in. exhaust fans with Blackman blades. These fans are furnished with six blades of a special shape designed to operate efficiently against pressure. The slow speed enables these fans to exhaust with a minimum of noise. Either standard blades or Blackman blades can be furnished with the exhaust fan motors.



Westinghouse Mechanically and Vane-Oscillated Desk Fans and Bracket Fans for 1911.

DEVELOPMENT OF ELECTRICAL DRIVE IN COTTON MILLS.

The Proximity Manufacturing Company, of Greensboro, N. C., operates two large cotton mills for the manufacture of indigo-blue denims. The company was organized in 1895 by Messrs. Moses H. and Cæsar Cone and associates. The Proximity Mill was erected and started in 1895, its equipment including 20,000 spindles and 1000 looms. A double spinning shift was instituted and the looms were operated only in the day time. According to the custom at that time the power house closely adjoined the mill, a 750-hp Corliss engine being belted directly to the head shaft in the spinning-room and separately belted to jack shafts between engine-room and weave shed.

As the business of the concern increased additions to the equipment were made until it was found that the engine was carrying about 20 per cent overload and to get satisfactory draft a fan had to be installed in the stacks. In 1900 the owners determined that better results could be obtained by restoring the engine to its rated load, and after a thorough investigation, decided to install a separate engine with generator to drive the weave-room. This was the first step taken by the company tending toward its present extensive system of electric drive.

The equipment consisted of a 250-kw, 100-r.p.m., 600-volt, three-phase, 40-cycle generator direct-coupled to a Corliss engine, the set being erected in the power house alongside of the first engine. Three 100-hp motors were installed in the basement of the weave-room, each motor being belted to four shafts. In ten years' continuous service the total expense chargeable to these motors has not exceeded $100. The only change made in the motor equipment was that automatic oil switches were substituted for the air-brake switches and fuses originally installed.

Before this installation was made careful readings were taken on the engine to determine the amount of power used in the weave-room. Similar readings were taken after the motors were installed (the number of looms having been increased 10 per cent in the meantime), which showed that almost exactly the same amount of power was required as before, but with an increased production of 15 per cent, it having been found possible to operate the looms faster with the motor drive. It was also found that for the same total output formerly carried on one engine the two engines consumed less steam and required less coal, and incidentally the fan was not required in the stack.

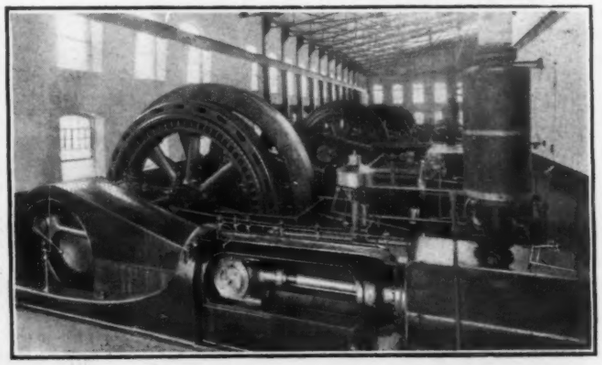


Fig. 1—View of Interior of the Genarating Station of the White Oak Mill.

In 1902 the owners decided to build a larger mill about two miles from Proximity, this mill now being known as the White Oak Mill. The site is an ideal one, being well elevated and surrounded by a thick growth of pine and oak. A considerable tract of woodland is set aside as a park for the benefit of the operatives. This mill has 60,000 spindles and 2000 looms, with the necessary preparatory machinery and dye house. The main buildings comprise a two-story picker building, 312 ft. x 78 ft.; a two-story spinning building, 750 ft. x 155 ft.; a weave shed, 904 ft. x 180 ft.; a dye house, 312 ft. x 105 ft., and a power house, 264 ft. x 136 ft., with two radial brick stacks 176 ft. high, one being equipped with a 12-ft. flue and the other with a 9-5-ft. fine.

The owners' experience at the Proximity Mill had convinced them of the advantages of electric drive, and the White Oak Mill was, therefore, laid out for that system of power distribution. The power house was placed to the west of the other buildings, as the land slopes in that direction, giving good facilities for the delivery of coal to the boilers and for handling the condensing water. One-half of the building is devoted to the boiler-room, which contains twenty-six Heine water-tube boilers, sixteen of 200 hp and ten of 250 hp. The other half of the building, which is separated from the boiler-room by a fire wall, is the engine and generator-room, with a considerable offset for the switchboard. Two generating units were installed when the mill was built, each unit consisting of a 1250-kw, 600-volt, three-phase, 40-cycle generator direct-coupled to a 2000-hp Corliss engine operating at 75 r.p.m. At the same time there was also installed one motor-driven and one steam-driven exciter, each of 50 kw and each capable of exciting the two generators. All feeder circuits are carried in an underground tunnel running from the switchboard to the several buildings.

Fig. 2—Interior View of Substation.

Fig. 3 is a view in the second story of the picker building. The two motors shown are each of 200-hp rating and are directly connected to the line shaft by two flexible couplings. In the first story there are three motors totalling 200 hp which operate the openers, etc. The first story of the spinning building contains two motors, each rated at 200 hp, which operate the cards, drawing frames, slubbers and speeders. The second story contains spinning frames aggregating 60,000 spindles, together with warpers, etc., all of which are driven by four motors, each rated at 200 hp, mounted on the ceiling and belted to countershafts, as shown in Fig. 4.

The looms in the weave shed are driven from below, the motors and shafting being located in the basement. In this building there are four motors, each of 150 hp, belted to four shafts. Fig. 5 shows some of the motors in basement of weave-room. It is noteworthy that this building is equipped in precisely the same manner that the weave-room at Proximity was equipped five years before—good evidence that the owners were well satisfied with their first experience. The dye house of this mill is unusually large and admirably appointed. The dyeing machinery is operated by a 100-hp motor, a similar motor being used for driving the slashers in another section of this building. This mill is operated single shift.

In 1907 it was decided to enlarge the power house at White Oak and drive the Proximity Mill therefrom, abandoning the mechanical drive, which had been retained there, except for the

weave-room. At the same time it was concluded to abandon night work at Proximity. This necessitated doubling the capacity of the yarn-making machinery at that mill, a new two-story building, 430 ft. x 130 ft., being erected for the purpose. A new dye house was also constructed and other improvements made, bringing the equipment of this mill up to 45,000 spindles and 1500 looms.

In the power house at White Oak there were added two 1500-kw, 600-volt, 40-cycle, three-phase General Electric generators, each coupled to a 2500-hp Corliss engine. The four

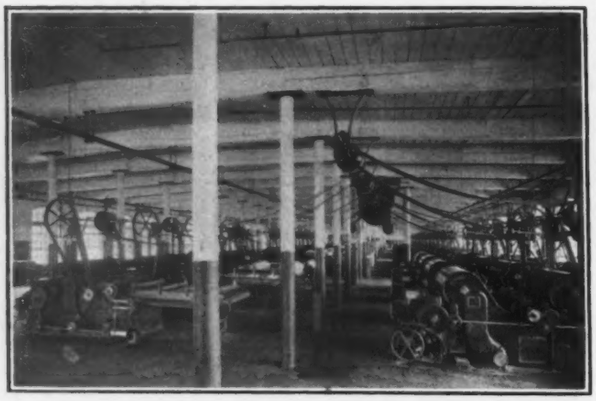


Fig. 3—Induction Motor Connected by Flexible Couplings to Shafts in Picker-Room.

units are shown in Fig. 1. The auxiliary equipment includes both motor-driven and steam-driven exciters. When this last enlargement was made a motor-driven exciter of 125-kw capacity was installed.

To transmit the required energy to Proximity it was necessary to step-up the voltage at White Oak and to step it down at Proximity. Consequently three single-phase, 40-cycle, 1000-kw, 600-15,000-volt, water-cooled transformers were installed in a brick building just outside of the switchboard-room at White Oak and a steel tower transmission line was erected to Proximity.

A substation for transformers and switchboard was also erected at Proximity, the building covering a ground area

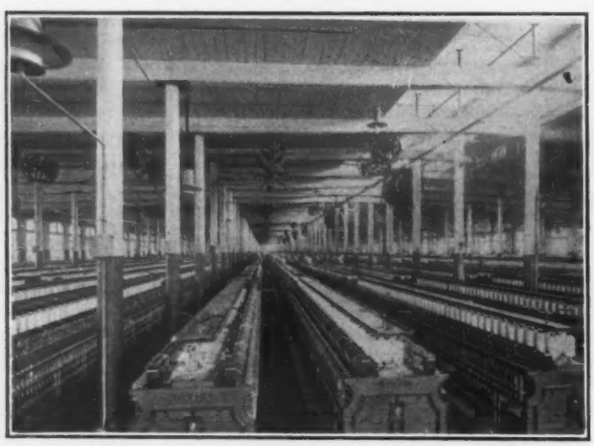


Fig. 4—Six 200-hp Induction Motors Belted to Shafts in Spinning-Room.

of 75 ft. x 30 ft. One end of this building is partitioned off by a heavy brick wall, and in the section so inclosed are placed three 40-cycle, 1000-kw, 15,000-600-volt, single-phase transformers and the lightning arresters, the transformers being located on a level with the ground. This section is full height of the building, giving ample room for high-voltage connections.

Fig. 2 gives an interior view of the main section of the substation building. Besides the switchboard, a 250-kw rotary concerter is installed, which furnishes energy for the direct-current arc lamps formerly served by a separate engine-driven generator. The handle of the 15,000-volt automatic oil switch controlling the primary of the transformers is also shown at the end of the switchboard, the switch being located in the transformer section.

The switchboards in the power house are of black-enameled slate and are of standard General Electric design, each generator-panel equipment including a watt-hour meter, as does also the panel controlling the line to Proximity Mill. On each feeder

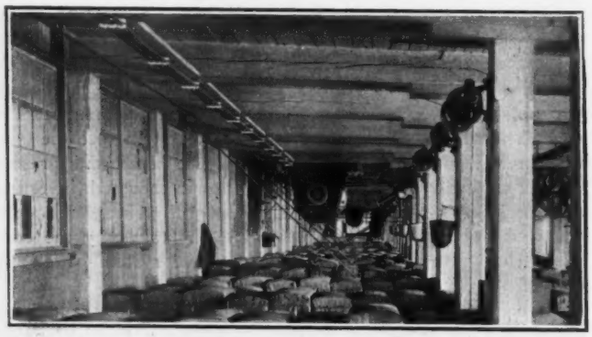


Fig. 5—Induction Motors Located in Basement of Weaving Building.

panel is an indicating wattmeter, and at the end of the board is a generator voltage regulator. These meters are read daily and a careful log is kept, by means of which the engineers are enabled to check the energy output against coal consumption, and also against the production of the mills. Very interesting and useful data are thus secured.

The complete electrical equipment includes: Two 1250-kw, two 1500-kw and one 250-kw, 600-volt generators; one 50-kw, 125-volt marine set; one 50-kw, one 25-kw and one 15-kw, 125-volt motor-driven generator sets; six 40-cycle, 1000-kw water-cooled transformers; one 250-kw, 250-volt, three wire rotary converter; 819 arc lamps, and the following standard 40-cycle, wound-rotor, 550-volt motors; ten 200 hp, nine 175 hp, three

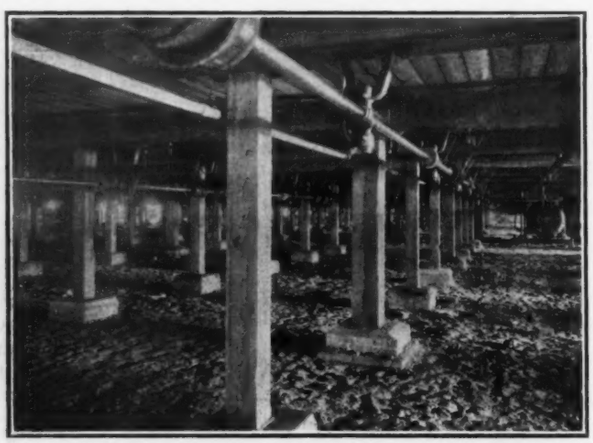


Fig. 6—Four 150-hp Induction Motors in Basement of Weave-Room.

150 hp, four 125 hp, five 100 hp, two 75 hp, one 60 hp and one 50 hp.

The mills use approximately 60,000 bales of cotton per annum. All mechanical and electrical problems are under the supervision of the general superintendent, Mr. R. G. Campbell, and his assistants, Messrs. U. S. Greer, steam engineer, and W. J. Dorwith, electrical engineer.

Industrial and Commercial News

THE WEEK IN TRADE.

BETTER conditions prevailed in commercial business last week than at any time since the beginning of the year. This was probably due for the most part to the better weather which was experienced in the South and West. Both jobbing houses and retail trade reported larger sales, and the former are in receipt of quite an encouraging volume of inquiries. This improvement, however, is purely seasonable and does not compare with that of the same seasons in ordinary years. There is still apparent a slow and cautious sentiment that makes small-lot buying the rule. The activity which has prevailed for some weeks past in materials for agricultural purposes is still in evidence, and implements are especially active. Although there have been some unfavorable reports concerning crops from the South and West, it is not believed that any serious damage has been done to fruits, and preparations for a large planting of leading crops are being reported. Traffic over the Western railroads is reported as being light, and the number of idle cars has considerably increased. Favorable reports continue to be received from the iron and steel industry. Shipments from the mills are increasing and new orders are coming in much more rapidly than heretofore. In this improvement the lighter finished lines are leading in activity. The mills are now turning out tin plate and wire to something like 90 per cent of their capacity. Better reports are being made in regard to pig iron and negotiations are pending for moderate purchases of railroad supplies. This improvement was somewhat checked at the end of last week by the unsettling news of the Interstate Commerce Commission's decision refusing to allow higher freight rates. Immediately upon hearing this decision quite a number of railroads intimated that their buying would be curtailed. Reports as to collections are not much changed. They are still regarded as from slow to fair, being affected in some places by the comparative failure of reduced-price retail sales. Business failures for the week which ended Feb. 23, as reported by *Bradstreet's*, were 228 as against 235 the previous week, 254 in the same week in 1910, 244 in 1909, 311 in 1908 and 194 in 1907.

THE COPPER MARKET.

LAST week showed some improvement in the local copper market. It is estimated that contracts for between 8,000,000 and 10,000,000 lb. of electrolytic copper were placed by domestic wire drawers and electrical equipment manufacturers. Most of these contracts were taken by one independent producing interest, which made concessions of from 5 to 10 points from the asking price of the Amalgamated. The total sales of these producers in February have been in the neighborhood of 30,000,000 lb., which includes some export business. Indications at the present time are that the total deliveries of copper during February, which is a short business month, will not exceed 90,000,000 lb., which, in spite of the fact that production will show considerable reduction, points to an increase in surplus of about 10,000,000 lb. As a rule, the quoted prices of copper during the past week have been a trifle firmer. While electrolytic is still quoted around 12½, the same as at the end of the previous week, it is general knowledge that fewer concessions have been made to purchasers. Standard copper on the Metal Exchange is quoted a trifle higher. Export business during the week improved slightly, and foreign consumers took advantage of the present prices, fearing that the apparent reduction in output would put the market in such a condition that such figures could not be again obtained. Much of the copper sold during the week to domestic consumers and for export was for delivery in April and May. Exports for the month, including Feb. 27, were 15,836 tons. The daily call on the Metal Exchange Feb. 27 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.10	12.20	....
February	12.10	12.20	12.15
March	12.10	12.20	12.15
April	12.10	12.20	12.15
May	12.10	12.20	12.15

The London market, Feb. 27, was as follows:	Noon. £ s d	Closing. £ s d
Standard Copper, spot	54 15 0	55 8 9
Standard Copper, futures	54 13 9	55 7 6

Extreme fluctuations for this year:	Highest.	Lowest.
Standard	12.30c	11.87½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 10 0

INDUSTRIAL AND COMMERCIAL NOTES.

Public Service Corporation Purchases.—The Public Service Corporation of New Jersey has ordered from the General Electric Company the following substation apparatus: For the City Dock station, a switchboard and regulators; for the Coal Street station, a switchboard; for the Paterson station, transformers and switchboard; for the Passaic substation, transformers, regulators and switchboard; for the Marion station, a switchboard; for the Metuchen station, a switchboard; for the Garfield Avenue substation, oil switches and switchboard apparatus; for the Hudson River substations, constant-current transformers, high-voltage lightning arrester equipment; for the Trenton station, induction regulators and switchboard apparatus; for the Rutherford substation, a constant-current transformer and switchboard; for the Englewood substation, constant-current transformers and switchboard; for the New Brunswick substation, high-voltage lightning arrester equipment and switchboard apparatus; for the Rahway station, high-voltage lightning arrester equipment and switchboard apparatus; for the Lincoln substation, switchboard apparatus; for the Plainfield station, switchboard apparatus; for the Montclair substation, switchboard apparatus, and for the Plank Road substation, feeder regulator and switchboard apparatus.

Westinghouse Electric Sales.—Among the recent sales made by the Westinghouse Electric & Manufacturing Company were four 3750-kva generators to the Oconee Construction Company for installation in the Eastern Tennessee Power Company, Parksville, Tenn. J. G. White & Company are engineers of this hydroelectric development. The Westinghouse company also sold all of the switchboard and auxiliary apparatus. The water-wheels were purchased from the S. Morgan Smith Company. The Westinghouse company has also sold to the Public Service Corporation of New Jersey three 5000-kw, 13,200-volt, 60-cycle turbo-generator units for installation in the new power house which is now nearing completion at Perth Amboy, N. J. In the same order were included three 100-kw exciters, switchboards and other apparatus. There was also purchased for the same station a rotary converter for the local service.

Washington Water Power Company.—Among the many improvements which the annual report of the Washington Water Company, of Spokane, refers to as being contemplated in 1911 are the completion of the hydroelectric plant at Little Falls; the construction of a new power plant at the same place; obtaining more water rights in the Spokane River and Lake Cœur d'Alene; placing wires in Spokane underground; extending light and power system; completing storage battery station and installing additional substation machinery in Spokane; building transmission line from Pend Oreille to Newport, Wash., and buying new railway equipment and minor apparatus. Quite a large amount of new construction was done during 1910 and considerable equipment was added.

Electric-Gasoline Car Test.—Representatives of the General Electric Company, together with officials of the New York Central Railroad, made trial trips last week in a new high-speed electric-gasoline car, which has just been completed by the former company. While no detailed report of the results of the test have been given out, it is said that a speed of seventy miles per hour was attained and that the apparatus worked in a thoroughly satisfactory manner.

Walpole Rubber Company.—The Walpole Rubber Company of Walpole, Mass., reports that the demand for insulating and friction tape, and all other insulating materials, has been exceedingly brisk since the first of the year, and that the factory has been kept busy. Over 10,000 lb. of insulating tape is turned out daily at the Walpole plant, which it is claimed is the largest output in the world from one establishment.

Power Station Equipment for the Minneapolis General Electric Company.—The principal equipment for the new power station of the Minneapolis General Electric Company to replace the station destroyed by fire on Jan. 7, 1911, has been ordered by the Stone & Webster Engineering Corporation, which has charge of the design and construction. There will be two 6000-kw, 2300-volt Allis-Chalmers turbo-generators, which will be stepped up to 13,000 volts by 2500-kw Allis-Chalmers transformers, of which six will be installed. The boiler equipment consists of ten 600-hp Babcock & Wilcox boilers supplying steam at 180 lb. working pressure. The steam will be superheated to 125 deg. by Foster superheaters. The turbine-room will be supplied with a four-motor Cleveland Crane & Engineering Company traveling crane, with a 60-ton main hoist and a 15-ton auxiliary hoist. The building will be of steel frame and brick construction and the stacks will be of steel.

Proposals for Sanitary District.—Sealed proposals for furnishing and installing an alternating-current generator (with motor-operated field rheostat), transformers and cables will be received by the board of trustees of the Sanitary District of Chicago, room 1500, American Trust Building, until noon on March 9. The generator will be an addition to the Lockport (Ill.) hydroelectric generating station. It must be of the water-wheel type, wound for 4000 kw. at 6600 volts, three-phase and 60-cycle. Three single-phase step-up transformers and three step-down transformers are required to be used with the new generator, raising the machine voltage in the power house from 6600 to 44,000 volts and reducing it to 13,200, 12,000, 9000 and 6600 volts at the terminal station in Chicago. Underground lead-covered cables of varying sizes and to conduct from 5000 to 12,000 volts, through from one to eight wires, are specified.

Westinghouse Sales.—The Natomas Consolidated of California, Marysville, Cal., has ordered about 1000 hp in motors from the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., to be used in operating a gold dredge. The use of 2200 volts direct on the motors has proved successful on an electric dredge that the company already has in operation, and the new motors will operate on the same voltage. The company has also received an order from Chalchuapa, Salvador, Central America, for generating apparatus and the lamps necessary for a small lighting and industrial service, including a 100-kva, three-phase, 60-cycle, 2200-volt waterwheel generator with exciter and switchboard; eighteen 1½-kva and four 2-kva transformers, single-phase, 60-cycle, 2200/110 volts; six 6.6-amp and twenty 6-amp alternating-current multiple inclosed arc lamps.

Allis-Chalmers Company.—The Allis-Chalmers Company reports that sales during February have improved to a considerable extent over the average of January. As yet they are nothing to boast of, but they offer more encouragement for the future than previously. The company is hardly operating at more than 50 per cent of capacity, and the bulk of the sales seems to be in flour-mill and mining machinery. Quite a number of turbo-generator sets have recently been sold, but none of very unusual size. An official of the company stated last week that the talk of a merger with the American Steel Foundries Company was absolutely ridiculous. He said that this was true if for no other reason than from the fact that such a merger would be of no benefit to either company.

National Lead Company.—The annual statement of the National Lead Company for 1910 has not yet been given out, but preliminary figures show ample justification for the reduction of the common dividend from the 5 per cent to the 3 per cent rate last July. The company is at present earning enough to pay the 3 per cent dividend, but could not have maintained the old rate without intrenching upon its surplus. The officials state that the company hopes to do a large spring business durin gthe present year.

Westinghouse Insulating Material Products.—The Westinghouse Electric & Manufacturing Company has recently placed upon the market a complete line of standard insulating material products. This includes both treated and untreated fabrics and papers, a complete line of friction tapes and rubber-splicing compounds, together with the various types of insulating glues, cements and gums, all of which are used in its works at East Pittsburgh in the manufacture of its standard electrical products.

Westinghouse Machine Company Sales.—The Westinghouse Machine Company has sold to the Northern Indiana Gas & Electric Company, of Chesterton, Ill., two 3700-kva steam turbines. These turbines will operate on a steam pressure of 175 lb. (100 deg. superheat) and will exhaust into a vacuum of 28 in. These turbines will be connected to 750-kva, 13,200-volt, three-phase, 60-cycle generators. The company has also sold to the Bradford (Pa.) Electric Light & Power Company one 17-in. x 36-in., 375-hp horizontal engine, which will operate on natural gas. The engine will be connected with a 250-kva, 2500-volt, 60-cycle, three-phase generator.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Herkimer, N. Y.; Waco, Tex.; Minot, S. D.; Elgin, Ill.; Miles, Tex.; Doerun, Ga.; Nortonville, Ky.; Tylertown, Miss.; Durant, Okla.; Bay Minette, Ala.; Live Oak, Fla.; Smithfield, N. C.; Albertville, Ala.; Portland, Ore.; Fairbury, Neb.; Franklin, Neb.; Baltimore, Md.; Etna, Pa.; Kansas City, Mo.; Auburn, Ind.; Moline, Ill.; San Antonio, Tex.; Monticello, Ark.; Ogden, Utah; Joliet, Ill.; Wheeling, W. Va.; Conneaut, Ohio, and Webster, Ia.

New Westinghouse Foundries.—A contract has been given to the American Bridge Company for the structural steel to be used in the erection of the new foundries of the Westinghouse Electric & Manufacturing Company at Trafford City, Pa. The work will begin within a few weeks. The contract calls for steel for two buildings, one 250 ft. x 50 ft., and the other 200 ft. x 65 ft. In all over 3000 tons of steel will be necessary The Westinghouse company has purchased thirty acres at this location and it is planned to have all the castings for the various companies produced in one series of foundries.

Idaho Hydroelectric Plants.—C. A. Reid, of Spokane, Wash., with whom are associated a number of Canadian capitalists, will erect a dam and a 4000-hp hydroelectric plant, costing in all $850,000, at Bruce's Eddy, on the North Fork of the Clearwater River, northern Idaho. W. C. Weeks, who has built piers in the North River, New York, N. Y., will have charge of construction. Thomas J. Humbird, of Spokane, has announced that his company, the Clearwater Tuner Company, will construct a hydroelectric plant at Orofino, northern Idaho, at the mouth of Whisky Creek.

St. Louis & Kansas City Electric Railway.—A contract has been let to the L. C. Smith Construction Company, of Kansas City, to build twenty-eight miles of the proposed St. Louis & Kansas City Electric Railway. It is said that bonds for the entire enterprise have been underwritten to the amount of $12,000,000 by French bankers.

United States Production of Platinum.—The Geological Survey has just issued a report of the production of platinum for the year 1909. Platinum in this country is produced only as a by-product of placer gold mining. The product in 1909 was 672 Troy oz., reported to be worth $12,803, a trifle over $19 an oz.

Financial.

The Week in Wall Street

WALL STREET market last week received one of those sudden blows which, while it had been more or less anticipated and presumably prepared for, caused a violent break in prices of railroad securities, and incidentally in the prices of those industrial securities which largely depend upon the railroads as customers. The decision of the Interstate Commerce Commission refusing to permit the scheduled advance in rates should have been anticipated. For months past there has been every indication that such a conclusion would be reached, and every expression that has come from members of the commission indicated this determination. The decision was not given out until after the close of the market on Thursday, and from that time until the opening of the Exchange on Friday morning the cables to London were loaded with orders, both to buy and sell. Timid holders attempted to protect their Wall Street interests by sales in the London market, while large banking interests came gallantly to the rescue in an effort to sustain prices in this market by liberal purchases in London. Taken altogether, the result was not so demoralizing as might have been anticipated. While in the first two hours of trading on Friday there was some excited selling and prices broke violently, the reaction came quickly and the close for most of the important stocks was only a few points below the close of the previous evening. In general terms, it may

be stated that Wall Street stood the blow in a very satisfactory manner. It also more fully demonstrated what had been fairly well known for many months, that the large financial interests centered in Wall Street do not intend to permit any demoralization of the market, if money can hold it up. Trading was not exceedingly heavy, and there was nothing at any time approaching a condition of panic. The net changes in prices for the week were mostly declines, the railroads, of course, leading in these recessions. From 3 to 5 points represented the most serious of these declines. United States Steel Common showed a net change of 3¼ points. This is largely due to the assumption that railroad managers will curtail their orders for rails and equipment to the point of absolute necessities. It has not as yet been given out what course the railroads affected by this decision will pursue, but it is the general belief in Wall Street that no appeal will be taken from the decision of the commission to the new Commerce Court. It may be that an effort will be made to test the validity of the law empowering the Interstate Commission to interfere with rates. The money market continues to be comparatively easy, and the bond market is fairly good. Rates for money Feb. 27 were: Call, 1 @ 2½ per cent; 90 days, 3¼ @ 3½ per cent. The quotations in the table are those of the close of Feb. 27.

NEW YORK.

	Feb. 18.	Feb. 27.	Shares Sold.		Feb. 18.	Feb. 27.	Shares Sold.
Al. Ch.....	7⅞*	7⅞*	——				
All. Ch., pf.	32*	31*	1,000	Int. Met., pf.	54	52½	5,675
Amal. Cop...	65¼	63⅜	35,400	Mackay Cos..	92½	91½	110
Am. D. T...	20½*	20½*	——	Mackay C., pf	76	76½*	100
				Man. Elev...	139¾*	139¾*	200
Am. Loco...	41¼	38	3,150	Met. St. Ry.	15*	15*	——
Am. Loco. pf.	110*	109¾	176	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	84½*	84½*	——	Steel, Com...	80⅞	77⅝	486,410
Am. T. & T.	146¼	144⅝	1,640	Steel, pfd....	119⅜	118¾	5,360
B. R. T....	78½	77⅞	15,900	W. U. T....	74½	73⅞	1,800
Gen. Elec....	153½*	152¼	2,600	West'h, com.	70	69⅝	1,000
Int. Met.....	19⅞	18¾	4,700	West'h, pfd..	119*	120	——

PHILADELPHIA.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Am. Rys.....	45	44⅞*	Phila. Elec.....	16½	16⅜
Elec. Co. of A.....	12⅜*	12⅜	Phila. R. T.....	19¾	20⅜
Elec. St. B'ty.....	55	53½	Phila. Trac.....	85*	85
E. S. B'ty., pfd....	30*	30*	Union Trac.....	47	47½

CHICAGO.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Chi. City Ry.....	185*	185*	Chi. Tel Co.....	121	123
Chi. Rs., Ser. 1.....	93*	92½	Met. El. Co.....	20¼	20
Chi. Rs., Ser. 2.....	24½*	23½	Met. El., pfd.....	65½*	66½*
Com. Edison.....	116*	120	Nat'l Car.....	117*	118¾*
Chi. Subways.....	4*	4⅜	Nat'l Car, pfd.....	118*	118½

BOSTON.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Am. T. & T.....	146¼	144⅝	Mex. Tel.....	4¾*	4½*
Cum. Tel.....	149*	149*	Mex. Tel., pfd.....	6*	6⅛*
Edison E., Ill.....	290¼	290	N. E. Tel.....	142	142
Gen. Elec.....	153½*	152½	W. T. & T.....	20½	20
Mass. E. Ry.....	17¼	17*	W. T. & T., pfd.....	95	94
Mass. E. Ry., pfd...	87½*	88			

*Last price quoted.
Shares sold for week Feb. 20 to Feb. 25.

FINANCIAL NOTES.

Independent Telephone Merger.—The negotiations continued last week, which were referred to in our last issue, looking to the merging of the leading Independent telephone companies in the Central West with the Bell system. No definite information was given out concerning the progress of these negotiations further than the announcement that they were proceeding satisfactorily. It is confidently predicted by all of the interests represented at the conference that they will be brought to a successful conclusion. It is also stated that the plans for the consolidation that are being worked out will in no way infringe the Sherman law. Both the Bell and Kinloch —Independent long-distance—companies of St. Louis held their annual meetings last week and re-elected their old boards of directors. No statements concerning consolidation were given out W. D. Orthwein, president of the Kinloch, has stated that his company is not a party to any negotiations.

Massachusetts Lighting Companies.—At the annual meeting of the stockholders of the Massachusetts Lighting Companies last week the trustees were authorized to issue 6800 shares of capital stock, $100 par, the proceeds to be used to purchase new property and also to make further additions and betterments to the present property. Not more than $250,000 of the new stock will be issued during the present year. It was also suggested at the meeting that the remaining shares be offered to shareholders at a subsequent date. The following trustees were elected: William M. Butler, two years; Percy Parker, one year; H. M. Whitney, three years: Alfred Clark, four years, and Arthur E. Childs, five years.

New Receiver for Chicago & Milwaukee Electric Railroad.—Judge Grosscup, of the United States Circuit Court in Chicago, has appointed W. O. Johnson, a director of the Western Trust & Savings Bank of that city, receiver of the Chicago & Milwaukee Electric Railroad Company. The three former receivers, Messrs. D. B. Hanna, George G. Moore and W. Irving Osborne, are retained in an advisory capacity. It is said that Mr. Johnson was appointed receiver because of his experience in previous receiverships. He is expected to bring the Chicago & Milwaukee Electric Railroad to a place where it can show what there is in the property, both in the way of earning power and as a public utility.

Washington, Baltimore & Annapolis.—Judge Morris, of the United States District Court at Baltimore, has signed a decree foreclosing the first and second mortgages on the Washington, Baltimore & Annapolis Electric Railway Company, amounting to $3,361,057 and $1,120,352, respectively, held by the Cleveland Trust Company, which is appointed trustee in the decree to conduct the sale under bond for $100,000. The decree orders that at the sale no bid under $2,500,000 shall be accepted. The receivers for the company declare that the foreclosure proceedings will not affect the schedule of the corporation in the operation of its system until after the sale which has been ordered for March 20.

Philadelphia Rapid Transit.—A majority of the stock of both the Philadelphia Rapid Transit and the Union Traction companies has been placed in the hands of a proxy committee to vote in favor of the E. T. Stotesbury refiancing plan. The only thing that remains to be done is to have the $10,000,000 loan which is proposed properly authorized by the City Council of Philadelphia, as the city is a quasi-partner in the properties. The business of the Rapid Transit company has shown considerable improvement since the first of the year over the same months last year. For the first half of February the receipts were about $40,000 ahead of those for a similar period in 1910.

Cumberland Telephone & Telegraph Company.—The Cumberland Telephone & Telegraph Company closed the most favorable year in its history Dec. 31. Liberal gains were shown in gross and net earnings, and the surplus was considerably increased. The balance available for dividends, after paying all fixed charges and a liberal amount for maintenance and depreciation, was equal to 12.23 per cent on the capital stock. The net for the year increased about $250,000. During the past few years the company has made vast extensions throughout the South, and at the present time its wires form a complete network from Nashville to New Orleans.

Wayne County Gas & Electric Company.—The Public Service Commission of the Second District of New York has given preliminary consent for the consolidation of the Wayne County Gas & Electric Company and the Geneva-Seneca Electric Company, the latter of which has recently purchased the J. Q. Howe's Sons property at Phelps, N. Y. The fact that this application had been made was referred to in our issue of Feb. 2. The final approval of the merger has not yet been formally made. With the completion of this consolidation it is planned to construct a transmission line from Newark through Phelps and Wayne County to Geneva.

Colorado Telephone Company.—At the annual meeting of the Colorado Telephone Company in Denver last week it was stated that the company's assets Jan. 1, 1911, were $3,971,450 in excess of the capital stock outstanding and that the gross revenue of the company increased $252,000 in 1910. At the end of the year the company was serving 80,967 subscribers in Colorado and New Mexico and in addition was connected with 8004 stations. The total mileage of wire was 188,384, of which 35 per cent was under ground. In Denver alone there are 31,600 subscribers.

Pacific Power & Light Company.—Clark, Dodge & Company and White, Weld & Company, both of New York, are offering $2,898,000 of 5 per cent bonds of the Pacific Power & Light Company to the public at 94 and interest. This company was organized last year by the American Power & Light Company as the holding concern for the properties in northern Idaho, western Washington and Oregon which had been gathered by H. M. Byllesby & Company, of Chicago, and were held by the Northwest Corporation.

Southern New England Telephone Company.—The financial report of the Southern New England Telephone Company, of New Haven, for 1910 shows total income of $2,706,012, an increase of $232,606 over the previous year. During the year, the plant account was increased $925,548, bringing the total up to $10,005,611. At the end of the year the company had connected 82,883 telephones.

General Railway Signal Company.—The balance sheet of the General Railway Signal Company of Dec. 31, 1910, shows assets as follows: Cash, $83,181; accounts and bills receivable, $742,671; Bouck C. T. C. Company, $85,550; inventory, $686,126; contract construction work, $156,245; miscellaneous, $9,106; factory plant, $136,962; machinery, fixtures, tools, etc., $748,230; patents and good will, $3,088,076; Young system, $260,000; prepaid items, $4,959; bond discount and taxes, $48,649; total, $6,649,757. Liabilities: Bills payable, $382,802; accounts payable, $141,898; employees' bond payments, $5,131; accrued interest, $1,360; bonded debt, $608,000; common stock, $3,000,000; preferred stock, $2,000,000; reserve, $95,656; profit and loss surplus, $314,909; total, $6,649,757.

Tampa Electric Company.—An offering has just been made of $300,000 of first-mortgage, 5 per cent bonds of the Tampa (Fla.) Electric Company. This company is controlled by Stone & Webster, of Boston. The net earnings of the company are now over five times the interest charges on all of the bonds, including the new offer, and the gross receipts show considerable expansion. The company does practically all of the electric railway, lighting and power business in Tampa, and operates an electric line between Tampa and Port Tampa. It operates more than forty miles of track, and has two power stations with a total capacity of 4425 kw.

Pacific Telephone & Telegraph Company.—While the gross earnings of the Pacific Telephone & Telegraph Company for 1910 amounted to $14,667,112, as compared with $12,885,018 for the previous year, the balance left available for dividends was less than in the previous year, owing to the fact that the special maintenance reserve account was largely increased. On Dec. 31 there was charged to this account $4,190,567. This charge was largely increased during the last four months of the year and indicates that a special effort is being made to put the property in the highest state of efficiency.

Connecticut River Power Company.—The first annual report of the Connecticut River Power Company gives the gross receipts for the year 1910 as $270,202. The net earnings, after paying operating expenses and taxes, were $161,134, which was a little more than enough to pay the interest on the bonds. It is stated that contracts have now been closed for the sale of practically all of the energy that is at present available. The company is at present distributing in Worcester, Gardner, Marlboro, Clinton, Fitchburg, Brattleboro and West Boylston.

Dominion Power & Transmission Company.—At the annual meeting of the Dominion Power & Transmission Company, of Hamilton, Ont., recently, the president, J. R. Moodie, announced that the directors thought it advisable to withhold the back dividends due on the preferred stock for the two years ending July 1, 1910. The dividend, at the rate of 7 per cent per year, was paid for the last half of 1910. The financial statement of the company showed gross earnings for the year of $1,922,398 and net earnings of $533,757.

Northern Ohio Traction & Light Company.—The directors of the Northern Ohio Traction & Light Company met last week and called a special meeting of the stockholders to authorize an issue of $3,000,000 of 6 per cent preferred stock Of this issue $1,000,000 will be sold at once to provide funds for the new power house to be built at Cuyahoga Falls. The new stock will probably be offered to the shareholders, but it is understood that tentative arrangements have already been made with a banking firm to underwrite it.

National Carbon Company.—The annual report for 1910 of the National Carbon Company shows that the net earnings were $1,303,296, as compared with $1,211,438 in the previous year. After allowing for the regular 7 per cent dividend on the $4,500,000 preferred stock, the balance is equal to 17.9 per cent on the $5,500,000 common stock. It will be remembered that in addition to this an extra dividend of 15 per cent was paid on Nov. 7, 1910, out of the profit and loss account. All of the old officers were re-elected.

Pacific Telephone & Telegraph Company.—The Pacific Telephone & Telegraph Company has made its report for 1910 in which it shows gross earnings to be $14,667,111, an increase of almost $2,000,000. The total number of stations operated by the company on Dec. 31, last year, as set forth in the report—including private lines—was 446,622. The business of the company has developed rapidly within the last few years.

Montreal Street Railway-Canadian Power Merger.—It is stated in Montreal that the negotiations leading to a consummation of the Canadian Light & Power Company merger with the Montreal Street Railway Company will be concluded within about ten days. C. H. Cahan, K.C., is now on his way back from London, England, and the securities of both companies have had a sharp advance of several points as a consequence.

American Light & Traction Company.—The officials of the American Light & Traction Company expect the company to show as large an increase in earnings this year as it did last, which was approximately $475,000. This would bring the net for 1911 up to about $4,188,000, which is equivalent to about 32 per cent on the common stock. In regard to stock dividends Emerson McMillin, chairman of the board, says that they will continue to be paid by the company even after the present treasury stock is used up, by increasing the capital, if the earnings of the company justify their payment. These dividends are being paid out of earnings, and Mr. McMillin says they represent money that is put back into the property. The American Light & Traction Company plans, during the present year, to spend 50 per cent more in improvements than last year or any recent year. The improvements will likely include two or three large gas holders.

Capital Traction Company.—The Capital Traction Company, of Washington, D. C., showed gross earnings in 1910 of $2,226,150, an increase of more than $200,000 over the previous year. The total number of revenue passengers carried was 51,307,792, an increase of 5,000,000. During the year the company expended $360,988 on roadway, $106,269 on equipment and $2,682 for general purposes.

Cleveland Electric Illuminating Company.—The Cleveland Electric Illuminating Company has disposed of $500,000 in new bonds and more than $1,300,000 new stock. The bonds were handled by an Eastern bank. Expenditures for improvements this year will reach $2,500,000.

DIVIDENDS.

Canadian Westinghouse Company, Ltd., quarterly, 1½ per cent, payable April 10.

Chicago Telephone Company, quarterly, 2 per cent, payable March 31.

Laclede Gas Light Company, quarterly, 1¾ per cent, payable March 15.

Louisville Traction Company, preferred, semi-annual, 2½ per cent; common, quarterly, 1 per cent, both payable April 1.

Mackay Companies, quarterly, preferred, 1 per cent; common, 1¼ per cent, both payable April 1.

New England Telephone & Telegraph Company, quarterly 1½ per cent, payable March 31.

Philadelphia Electric Company, quarterly 1½ per cent, payable March 15.

Portland (Ore.) Railway, Light & Power Company, common, quarterly, 1 per cent, payable March 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BELL TELEPHONE COMPANY OF CANADA.						
Year,	1910	$58,510,685	$3,963,060	$1,547,125	$1,000,000	$547,125
"	1909	4,949,197	3,480,308	1,468,889	1,000,000	468,889
BUFFALO GENERAL ELECTRIC COMPANY.						
Year,	1910	$1,085,311	$665,523	$463,235	$133,887	$329,348
"	1909	967,455	599,722	408,361	123,299	285,061
FEDERAL LIGHT & TRACTION COMPANY.						
Year,	1910	$761,736,	$447,190	$314,546	.....	.....
"	1909	697,157	465,293	231,864	.....	.....
GEORGIA RAILWAY & ELECTRIC COMPANY.						
Year,	1910	$4,040,886	$1,908,444	$2,132,442	$847,605	$1,330,691
"	1909	3,673,007	1,700,142	1,902,865	845,242	1,095,677
KANSAS CITY RAILWAY & LIGHT COMPANY.						
Jan.,	1911	$656,606	$355,486	$301,120	$188,071	$113,049
Jan.,	1910	611,919	324,451	287,468	169,632	117,836
KEYSTONE TELEPHONE COMPANY.						
Jan.,	1911	$96,091	.....	$47,756	.....	$23,318
"	1910	94,314	.....	44,407	.....	18,049
7m., Jan.,	'11	668,571	.....	335,153	.....	163,646
7 " "	'10	645,367	.....	321,375	.....	143,855
KINGS COUNTY ELECTRIC COMPANY.						
Jan.,	1911	$447,910	$199,991	$247,919	$118,052	$129,867
"	1910	393,217	168,304	224,913	106,271	118,642
NORTHERN OHIO TRACTION COMPANY.						
Jan.,	1911	$186,271	$106,904	$79,367	$44,429	$34,938
"	1910	164,944	94,500	70,444	43,292	27,152
SHAWINIGAN WATER & POWER COMPANY.						
Year,	1910	$991,029	$127,386	$863,643	$456,388	$407,255
"	1909	819,171	118,048	701,123	379,816	321,307
TOLEDO RAILWAYS & LIGHT COMPANY.						
Year,	1910	$2,985,382	$1,868,600	$1,116,782	$926,381	$190,401
"	1909	2,733,178	1,627,337	1,105,841	778,286	327,555

General News

Construction News.

ALBERTVILLE, ALA.—At an election held Feb. 20 the proposition to issue $7,000 in bonds, the proceeds to be used for the installation of an electric light plant, was carried. J. W. Taylor, of Albertville, Ala., is engineer in charge.

BAY MINETTE, ALA.—Hampton D. Ewing, of the Bay Minette Land Company, and W. H. Isabell, of Bowling Green, Ky., are reported to be interested in a project to establish an electric light plant in Bay Minette. The cost of the proposed plant is estimated at $20,000.

BIRMINGHAM, ALA.—Arrangements are being made by the People's Home Telephone Company for improvements and extensions to its system, which will involve an expenditure of about $50,000, including the establishment of a new exchange in Woodlawn and extensions of its lines into every suburb of the district.

MONTICELLO, ARK.—Proposals will be received at Monticello, Ark., until March 15 for the installation of an electric-light plant to replace the plant that was recently burned. The equipment for the proposed plant will include two 72-in. x 16-ft. return tubular boilers; one 75-kw and one 100-kw alternating-current generators, direct-connected, with switchboards, wiring, piping, fittings, boiler-feed pumps, feed-water heater and all accessories for a complete electric plant, with exception of building. Plans and specifications are on file at the office of the commissioners, Monticello, Ark. N. C. Roe is chairman.

CHICO, CAL.—The Sacramento Valley Power Company has extended its transmission lines to the Butte Creek dredges, east of this city. It is said that the company contemplates many other extensions and improvements to its system.

CORCORAN, CAL.—The San Joaquin Light & Power Company is reported to be preparing to erect a transmission line to Angiola in addition to the extensions on the Waukens line. Ralph Beardon is local manager.

EL CAJON, CAL.—It is reported that the City Club is considering the question of installing an electric light system in El Cajon. It is proposed to extend the system from La Mesa to this city.

FRESNO, CAL.—It is reported that the Fresno Traction Company is planning to extend its car lines to the cemetery, Arlington Heights and Fresno Avenue toward Kleinhurst.

FRESNO, CAL.—The San Joaquin Light & Power Company has purchased the distributing system of the West Side Light & Power Company. This makes the third system the San Joaquin company has taken over in the last six months, the first being the Merced Gas & Electric Company, the next the Power Traction & Light Company and West Side Light & Power Company. At present all the power for Maricopa and Taft is generated by a steam plant in Maricopa. A. G. Wishon is general manager.

GERBER, CAL.—Arrangements are being made to organize a company to be known as the Gerber Water & Light Company. The company will be capitalized at $50,000 and the principal place of business will be located at Sacramento. The company proposes to own and control water rights and to supply water for domestic, mining, irrigation and other purposes; also to supply electricity for lamps and motors, which will be purchased from one of the large electrical companies. Artesian wells will be bored in Gerber for the local water supply. Edward H. Gerber, George W. Pelton, F. W. Peltier and F. W. Kiesel, all of Sacramento, are interested in the project. Gerber has not a post office.

GILROY, CAL.—The Coast Counties Power Company is reported to have submitted a proposition to the City Council offering to make several extensions to the transmission lines of the municipal electric light plant on a percentage basis. S. W. Coleman, of Santa Cruz, Cal., is manager of the Coast Counties Power Company.

HAYWARD, CAL.—I. B. Parsons, president of the Bank of Howard, purchased the franchise sold by the Board of Trustees on Feb. 15 for a street railway to run from the Southern Pacific station via Front, C, Commercial and B Streets to the eastern city limits. Under the terms of the franchise work is to begin on construction of the railway within three months.

MANTECA, CAL.—The new substation of the Sierra & San Francisco Power Company at Manteca has been put into operation, and the transmission line from station to Modesto, twenty miles in length, which will supply electricity in Modesto and Oakdale and in the South San Joaquin Irrigation District, has been completed. At Manteca and Ripon arrangements are being made to light the towns with electricity, and as the demand arises secondary lines will be erected into the farming districts to furnish electrical service.

MARTINEZ, CAL.—Initial steps to secure the installation of a municipal electric-light plant in Martinez have been taken by the Martinez Business Men's Association, which has appointed a committee to confer with the officials of the Great Western Power Company and also with the City Electric Company, of San Francisco, Cal., in regard to supplying electricity for same. The committee will also visit the municipal electric-light plant at Palo Alto and report at a mass meeting of citizens. The action taken is the outcome of the raise in rates and the refusal of the Pacific Gas & Light Company to pay 3 per cent of its gross receipts to the town. The Contra Costa Lighting & Power Company, which formerly supplied the town, paid a similar proportion of its gross earnings. When the Pacific company purchased the plant last July it refused to continue to pay this percentage to the town under a ruling of the United States Supreme Court.

MARTINEZ, CAL.—The Great Western Power Company has applied to the Board of Trustees of Martinez for a franchise to supply electricity in Martinez. The company has extended its transmission lines from the Sierra to the bay cities along its main line, which extends across Contra Costa County. The company has been supplying electricity to operate the works of the Cowell Cement Company at the base of Mount Diablo, where it has erected a substation. Recently the company erected a transmission line to the plant of the Peyton Chemical Company, near Martinez, and is now furnishing energy to operate the plant. The promoters of the Oakland & Antioch Electric Railway have contracted with the company to furnish electricity to operate the proposed railway. A number of contracts have recently been signed calling for service in the fall. From Peyton the transmission line will extend down the bay shore through all the towns there and on to Richmond, to which a line has already been built from Oakland. Martinez will be the first city to be supplied from this branch line.

OAKLAND, CAL.—Preparations are being made by the Oakland Gas, Light & Heat Company for the installation of a steam-heating system in Oakland at a cost of about $100,000. The company has already secured permission from the Board of Public Works to lay pipes in the streets of the city.

OAKLAND, CAL.—The large power plant of the Southern Pacific Railroad Company was put in operation Feb. 13. The plant has an outfit of 12,000 kw and will supply electricity to operate the suburban system of the company. Provision has been made to increase the output to 30,000 kw if necessary. Another substation is to be constructed in West Oakland, at a cost of $150,000. Transmission lines will be extended from the main plant carried on steel bridges, supported across the tracks, with two steel towers, 216 feet high, carrying the cables across the estuary. Current will be transmitted at 13,000 volts.

ORLAND, CAL.—The Board of Trustees has granted C. R. Wickes a franchise to erect and maintain transmission lines over the streets and highways in Orland for the distribution of electricity for lamps and motors.

PLACERVILLE, CAL.—Notice of appropriation of 100,000 in. of water in the middle fork of the Cosumnes River at a point near the mouth of Perry Creek has been filed by C. F. Peters. It is understood that the water is to be used for power, irrigation, municipal and domestic purposes.

PRINCETON, CAL.—C. R. Wickes and A. S. Linstrom, of Willows, representing the Superior California Power Company, a subsidiary company of the Northern California Power Company, have been in Princeton making investigations with a view of placing contracts for electrical service with the company. Plans are being made by the company to extend a transmission line here and one to Butte City, the latter to supply electricity in that place and to several large land companies on the east side for pumping water for irrigating purposes.

RED BLUFF, CAL.—Notice of appropriation of 10,000 in. of water of Mill Creek has been filed by Fred T. Horton, of Berkeley, Cal., to be used for generating electricity and power purposes.

SACRAMENTO, CAL.—John A. Britton, vice-president and manager of the Pacific Gas & Electric Company, has submitted a schedule of reduced rates for electricity for lamps to the executive committee of the Retail Merchants' Association. The prospect of cheaper rates for lighting follows an investigation of the subject recently by a committee of the Association. C. W. McKillip is general manager.

VALLEJO, CAL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 21 for furnishing at the Navy Yard, Mare Island, Cal., two turbo-generator sets, a motor generator set and switchboard, as per schedule 3355.

YREKA, CAL.—Notice of appropriation of 150,000 miners' inches of water of Klamath River has been filed with the County Recorder by the Siskiyou Electric Power & Light Company.

GREELEY, COL.—In the issue of Feb. 9 an item was published stating that the Denver, Greeley & Northwestern Railroad Company had secured rights-of-way and important terminals for its proposed electric railway between Denver and Greeley, giving the name of J. D. Houseman as general manager of the company. George J. Spear is president of the Denver, Greeley & Northwestern Railroad Company, with which company Mr. Houseman has no connection whatever.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until March 21 for furnishing and installing lighting fixtures in the United States buildings at Aiken, S. C.; Cleveland, Tenn.; Concord, N. C.; Griffin, Ga.; High Point,

N. C.; Newman, Ga.; Rome, Ga.; Catlettsburg, Ky.; Danville, Va., and Frankfort, Ky., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 28, for furnishing at the various navy yards and stations the following supplies: Brooklyn, N. Y., schedule 3307, wireless telegraph sets; schedule 3348, carbons for arc lamps; schedule 3349, condenser tube pipe fittings, etc. Norfolk, Va., schedule 3348, vibrating bells, night signal lanterns, lamp fixtures and interior fittings and branch junction boxes. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—The Senate Committee on Commerce on Feb. 19 directed a favorable report on the bill authorizing the Long Sault Development Company, of New York, to construct a power dam across the St. Lawrence River, south of the international boundary line, near Long Sault Island, N. Y. The bill was amended by the committee. The life of the franchise was reduced from ninety-nine to fifty years, and provision was made that before any work is done the plans must be approved by the International Joint Commission, to be approved in accordance with the treaty of 1910, or by such other tribunal as may be agreed upon by the governments of both the United States and Canada. Actual construction work must begin within two years and be completed within fifteen years.

LIVE OAK, FLA.—The Live Oak Electric Company is contemplating extensions to its plant, which will involve an expenditure of about $5,000. Bids for the proposed work will be received about April 1. C. E. Jones is vice-president and general manager of the company.

BARNESVILLE, GA.—The City Council has authorized Mayor T. W. Cochran to enter into a contract with the Central Georgia Power Company to supply electricity to the city. A site has already been selected for the station in Barnesville and it is expected that work will soon begin on the installation of the system. The company will also supply power to various manufacturing plants.

DOERUN, R. F. D. MINTON, GA.—Bonds to the amount of $15,000 have recently been voted by the city, the proceeds to be used for the installation of an electric light plant and erection of school building.

BOISE, IDAHO.—The installation of cluster lamps in the business section of the city is reported to be under consideration.

ALGONQUIN, ILL.—The Council has granted D. W. Thomas, owner of the local electric-light plant, a new franchise for a term of twenty years. It is said that the plant will be remodeled.

BUSHNELL, ILL.—Application has been made to the City Council by Rufus Lybarger, acting for A. L. Florey and F. W. Copeland, for a twenty-five-year franchise to install and operate a telephone system and exchange in Bushnell.

CARLINVILLE, ILL.—The contract for installing a lighting plant in the Macoupin County Almshouse, bids for which were opened Feb. 7, has been awarded to Fairbanks, Morse & Co., of St. Louis, Mo. W. C. Seehausen is county clerk.

CHICAGO, ILL.—Proposals will be received by the Board of Directors of the Chicago Public Library, Chicago, Ill., until March 4, for electric and gas fixtures for the Hiram Kelly Branch Library, at the corner of Normal Avenue and Sixty-second Street. Specifications are on file in the office of the secretary of the board, and copies may be obtained at the office of Frost & Granger, architects, 181 LaSalle Street, Chicago, Ill. H. G. Wilson is secretary.

DECATUR, ILL.—Property owners on five blocks of North Main Street have petitioned the City Council for permission to erect cluster lamps, the city to supply electricity to maintain them.

ELGIN, ILL.—The City Council has practically decided to install an electric light plant at the pumping station plant and will probably appropriate $5,000 to make a beginning on the work. The lease of the old municipal electric light plant to the Aurora, Elgin & Chicago Railroad Company will expire in 1915, when it is expected that the city will take over the street lighting system again. It is also expected by that time that State legislation will allow cities to supply electricity for general consumption. At present municipalities are allowed to supply electricity only for municipal purposes.

FREEBURG, ILL.—Sealed proposals will be received by the Village Board until March 6 for furnishing 150 electric meters. Charles Kessler is village clerk.

JOLIET, ILL.—The Illinois Valley Gas & Electric Company has purchased the electric plants at Havana and Mendota, Ill., making over forty towns supplied by the company. The Illinois Valley Gas & Electric Company secures electricity from the power plant of the Commonwealth Edison Company, at Chicago, and its transmission lines extend 165 miles into the center of the State.

JOLIET, ILL.—The Economy Light & Power Company is contemplating extensive improvements to its systems, involving an expenditure of about $500,000. The work includes extending and rebuilding its lines at Coal City, Braceville, Gardner, Streator, Ottawa, Sparland, Chillicothe, Dwight, Odell; building water tower and laying new water mains at Chillicothe; laying and improving gas mains and systems at Ottawa, Marseilles and Morris.

LINCOLN, ILL.—The installation of a municipal electric light plant in Lincoln is reported to be under consideration.

LITTLE YORK, ILL.—A movement has been started by residents of Little York to purchase the local telephone exchange and county lines and form a farmers' company. Charles Cooper is chairman of the committee formed to take charge of the project.

LYNDON, ILL.—A bill granting H. S. Green, Edward Smith and John J. Hurlburt, of Morrison, to construct a power dam at Lyndon, near Sterling, was recently passed by the House of Representatives at Washington, D. C. It is understood that the Sterling-Moline Traction Company is interested in the project. The cost of the proposed dam and power plant at Lyndon is estimated at approximately $450,000. The plant when completed, will supply electricity to Morrison, Lyndon, Erie, Prophetstown and Tampico and other towns and villages within a radius of fifty miles.

MACOMB, ILL.—The Illinois Western Telephone Company has been reorganized under the name of the Western Illinois Telephone Company. The capital stock of the company has been increased from $200,000 to $2,000,000. The company has filed a trust deed in favor of the Western Trust & Savings Bank to secure an issue of $2,000,000 in bonds, the proceeds to be used to enlarge and improve its service. The company now owns and operates about 1600 miles of toll lines.

MOLINE, ILL.—It is reported that the Tri-City Railway & Light Company is contemplating extensive improvements to its systems in Moline, Rock Island, Ill., and Davenport, Ia., which will involve an expenditure of about $750,000. It is understood that the greater portion will be spent for street railway extensions in Moline.

ROCK ISLAND, ILL.—The Tri-City Independent Home Telephone Company, having failed in an attempt to purchase the property of the Union Electric Telephone & Telegraph Company, has applied to the City Council for a franchise to construct and operate a telephone system in Moline.

AUBURN, IND.—Plans are being considered by the City Council for the installation of a complete new municipal electric-light plant. The present plant was installed twelve years ago and has more than paid for itself.

BEDFORD, IND.—The Bedford Power Company, which is erecting a large dam across White River at Williams, ten miles west of Bedford, is making rapid progress with its work. The company is installing an emergency plant to be operated by steam until the hydraulic plant is completed. The company proposes to supply electricity for lamps and motors in this vicinity and has already entered into a contract to supply power to operate the pumping station of the Bedford water works and also to several stone quarries and factories in and near Bedford. Eventually the company expects to extend its transmission lines to supply electricity to all stone quarries and mills in the stone district, covering a distance of about 100 miles.

COLUMBIA CITY, IND.—Preparations are being made to equip the municipal electric light plant to furnish a twenty-four-hour service, to cost approximately $10,000. Bids will be received for the work about March 27. F. T. Schultz is superintendent.

ELKHART, IND.—Plans are being prepared by the Home Telephone Company for the construction of a new telephone exchange building and the installation of an automatic switchboard. The company has applied for a new franchise.

INDIANAPOLIS, IND.—Representative Cravens has introduced a bill in the Legislature providing for the construction and equipment of a heat, light and power plant to be owned and operated by the State, to furnish light, heat and power to the State institutions, the Capitol building and the State Soldiers' Monument. A bill has been introduced by Senator White for the regulation of the price of light, heat and power in cities where the same is not fixed by ordinance.

LAFAYETTE, IND.—The Lafayette Telephone Company is contemplating installing a telephone system in West Lafayette, plans and specifications for which will be prepared at once.

NEW PARIS, IND.—The New Paris Mutual Telephone Company is fitting up a new exchange building, in which considerable new equipment will be installed.

PORTLAND, IND.—The report of Prof. C. F. Harding, of the electric department of Purdue University, employed by the City Council to make an examination of the municipal electric-light plant, recommends the installation of a soft-water feeding device for boilers, rewiring of switchboard and service lines; other improvements were also recommended.

COUNCIL BLUFFS, IA.—The Bell Telephone Company is reported to have secured the control of the Council Bluffs Telephone Company, one of the largest independent telephone systems in the West. The Council Bluffs company owns, in addition to the city exchange, long-distance lines extending into Missouri, east in Iowa, and northward into Minnesota.

HUMESTON, IA.—It is reported that the proposition to grant a franchise for the construction of an electric light plant in Humeston will be submitted to a vote.

WEBSTER CITY, IA.—It is reported that bids will be received by the City Council for construction of an electric-light and power plant, the cost of which is estimated at $40,000.

KANSAS CITY, KAN.—At an election held Feb. 15 the citizens voted in favor of the proposition to issue $350,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant.

KANSAS CITY, KAN.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 20 for an electric passenger elevator in the extension of the United States post office at Kansas City, Kan., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

MULBERRY, KAN.—The City Council is reported to be considering the question of calling an election to submit the proposition to install a municipal electric light plant to a vote. The cost of the proposed plant is estimated at $20,000.

SEVERY, KAN.—The City Council has granted a franchise to W. H. and Earl J. Mathis, of Wichita, Kan., to erect and operate an electric light plant in Severy, for a period of twenty years. Work will begin on the proposed plant in the near future.

NORTONVILLE, KY.—It is reported that the Nortonville Coal & Coke Company is planning to install an electric plant and will supply electricity for lighting the city.

MANCHESTER, MAINE.—The Kennebec Light & Heat Company, of Augusta, Maine, has applied to the Selectmen for a franchise to erect its transmission lines in the town of Manchester.

BALTIMORE, MD.—Plans are being prepared by the Consolidated Gas Electric Light & Power Company for the construction of a storage-battery plant at a cost of about $300,000.

SYKESVILLE, MD.—The board of managers of the Springfield State Hospital for the Insane is reported to have approved the plans for power house and two additional cottages. Dr. J. Clement Clark is superintendent.

BOSTON, MASS.—The stockholders of the Massachusetts Lighting Company have authorized the trustees to issue 6800 shares of capital stock at par, making the total capitalization $4,212,800. The trustees were also given authority to purchase the stock of any corporation engaged in engineering or construction work, in order to secure the supervision in which they are authorized to invest, and to borrow funds temporarily to acquire stock of such corporation.

OAK BLUFFS, MASS.—The Vineyard Lighting Company is reported to be contemplating moving its plant from Eastville to a point near the Vineyard Haven Beach wharf, where it will build a new plant and wharf.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has applied to the Legislature for permission to sell electricity. The primary reason is to supply electricity for operating trains through the Hoosac Tunnel.

SPRINGFIELD, MASS.—The State Board of Gas and Electric Light Commissioners has granted the United Electric Light Company permission to issue 2500 shares of new capital stock at $200 per share, par value $100 per share, the proceeds of 1875 shares to be applied to the cancellation of obligations of the company outstanding on Sept. 30, 1910, and the proceeds of 625 shares in payment of obligations incurred on account of additions to the plant since Sept. 30.

STOW, MASS.—The residents of Stow lower village have petitioned the Board of Public Works of Hudson to extend the transmission lines of the municipal electric plant to supply electrical service in this village. The town of Hudson has a franchise to install an electric system in Stow and has already extended its lines to Gleason, part of Stow, furnishing electricity there for three years. The extension asked for would involve an expenditure of about $5,000. If the town of Hudson refuses to furnish the service it is expected that a franchise will be given to the American Woolen Company, of Maynard.

WEBSTER, MASS.—Announcement has been made by the Webster & Southbridge Gas & Electric Company of a reduction in the prices for gas and electricity in the towns of Webster, Southbridge, Oxford, Dudley and Sturbridge, the new rates to go into effect March 1. Electricity will be furnished at a net rate of 13 1-2 cents per kw-hour and gas at $1.25 per 1000 cu. ft. The present rate for electricity is 15 cents per kw-hour. The reduction was voluntary on the part of the company. H. S. Shaw is superintendent of the company.

WORCESTER, MASS.—The Coughlin Electric Company has been awarded the contract for supplying the electric lighting fixtures for the new union station, to cost about $7,000.

MANISTEE, MICH.—The plant and holdings of the Manistee Light & Traction Company will be sold on March 15. The property includes the electric and gas plants and street railway system.

MARQUETTE, MICH.—The Light and Power Commission has decided to ask the City Council to submit the proposition to issue $100,000 in bonds, the proceeds to be used for enlarging and improving the municipal electric light plant, to a vote of the people at the spring election to be held April 3. The proposed improvements include the construction of two new dams, one at Silver Lake, and the other one at the head of the flume, and acquisition of the necessary flowage rights. The cost of the Silver Lake dam with flowage rights is estimated at about $26,000 and replacing the dam at the head of the flume with a new dam ten feet higher, with flowage rights, is estimated at about $75,000. The raising of the Silver Lake dam will increase the output of the plant by 150 hp.

LANESBORO, MINN.—It is reported that a company has been formed to build a telephone system in Lanesboro. M. W. Williams is president and A. M. Hanson secretary.

ST. PAUL, MINN.—A bill has been introduced in the Minnesota Legislature by Senator Hackney giving the cities of the first class the right to enter into lighting contracts for terms not exceeding two years.

SWANVILLE, MINN.—A new telephone company has been organized by the farmers in Bruce Township.

McCOMB, MISS.—The City Council is reported to have decided to establish a municipal electric light plant to be operated in conjunction with municipal water works system. The contract for street lighting with the McComb City Electric Light & Power Company will soon expire.

TYLERTOWN, MISS.—The City Council is reported to be considering a proposition submitted by Xavier A. Kramer, of Magnolia, Miss., for the installation of an electric light plant and water works system in Tylertown.

KANSAS CITY, MO.—The St. Louis-Kansas City Electric Railway Company has awarded the contract for the construction of an electric railway between Kansas City and St. Louis to the L. J. Smith Construction Company, of Kansas City. The contract calls for the construction of 140 miles of road at a cost of about $10,000,000. Work will begin as soon as the weather permits. A ten-mile branch is to be built from Columbia to Harrisburg.

ST. LOUIS, MO.—Plans are being prepared by the Easton Avenue Business Men's Protective Association to install new electric lamps on Easton Avenue between Leffingwell and Grand Avenues and also on a portion of Franklin Avenue.

GREAT FALLS, MONT.—The City Council has decided to install two additional 2,000,000-gal. electrically driven centrifugal pumps, bids for which have been received.

YAKT, R. F. D., TROY, MONT.—J. H. Ehlers, of Spokane, Wash., is reported to have located a water power site at Yakt Falls, where he proposes to erect a hydroelectric power plant capable of developing 5000 hp. It is also proposed to erect a transmission line from the gold camp to a point on the Great Northern and also one to the Sylvanite mine.

FAIRBURY, NEB.—Bids will be received at the office of the City Clerk, Fairbury, Neb., until March 9, for furnishing material and labor for extensions to water-works system and electric light plant, for which separate bids will be received as follows: 1. For furnishing material (except as outlined in subsequent items) and extending water-works and electric lighting systems). 2. For furnishing cast-iron pipe and special castings. 3. For furnishing hydrants and valves. 4. For furnishing and erecting one 2,000,000-gal. Meyer gear pump. 5. For furnishing generator, switchboard and 100-kw steam turbine set. 6. For furnishinig surface condenser and feed water heater. Plans and specifications are on file at the office of the City Clerk, Fairbury, Neb., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo.

FRANKLIN, NEB.—At an election held recently the citizens voted to issue $8,000 in bonds, the proceeds to be used for the construction of an electric light plant. W. E. Donner, of Grand Island, Neb., is engineer. H. A. Chitwood is Mayor.

HOLDREGE, NEB.—Proposals will be received at the office of the Board of Supervisors of Holdrege until March 14 for furnishing and installing furniture and fixtures in accordance with drawings and specifications prepared by W. F. Gernandt & Company, architects, Fairbury, Neb., as follows: No. 1, 2, 3 and 4 for furniture; No. 5 for electric lighting fixtures, and No. 6 for enameled steel vault fixtures. Plans and specifications may be obtained from the architects. C. Hedlund is clerk.

PLATTSMOUTH, NEB.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 20 for a conduit and wiring system in the United States post office building at Plattsmouth, Neb., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the superintendent at Plattsmouth, Neb. James Knox Taylor is supervising architect.

MANCHESTER, N. H.—The city Water Department has recently purchased a 5,000,000-gal. turbine pump from the De Laval Steam Turbine Company for pumping service in connection with its reservoir system. The pump will be operated by a 200-hp, three-phase, 60-cycle, 2000-volt motor.

SOMERSWORTH, N. H.—A bill has been introduced in the State Legislature asking for the right to equip and maintain a municipal electric light plant in the City of Somersworth. Electrical service in this city is now furnished by the Twin State Gas & Electric Company, of Dover, N. H.

ATLANTIC CITY, N. J.—The Board of Utility Commissions has approved the application of the Atlantic City Electric Company to issue $10,000 in bonds.

TRENTON, N. J.—Arrangements are being made by the lamp committee to call for bids for lighting the streets and public buildings with electricity for terms of one, three and five years. The Public Service Corporation of New Jersey now supplies the service, the contract for which will soon expire.

UNION, N. J.—The question of lighting the streets of the town by electricity is now under consideration.

FARMINGTON, N. M.—The City Council is considering the question of submitting the proposition to issue bonds, the proceeds to be used for

the installation of a water-works pumping plant and distributing system and a municipal electric-light plant. A local company is also being formed to install an electric-light and power plant in Farmington.

FARMINGTON, N. M.—Announcement has been made that the Rockwood Power Company, which has a large plant at Durango, contemplates extending its transmission line down the Animas River Valley to Farmington to supply electricity for operating irrigating pumps for farmers and also to furnish electricity for lamps and motors in the towns of Aztec, Flora, Vista, Kirtland, Fruitland and Farmington.

FORT BAYARD, N. M.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Bayard, N. M. ,until March 18 for furnishing, including installation, one motor-driven submerged-type centrifugal or impeller-type pump having a capacity of not less than 200 gal. per minute. Plans, specifications, blank proposals and other information furnished on application. Captain J. R. McAndrews is constructing quartermaster.

BINGHAMTON, N. Y.—The ordinance introduced by Alderman Hastings providing for a special election to be called by the city to vote on the proposition to issue $158,000 in bonds for the installation of a municipal electric light plant was defeated in the City Council.

BROOKLYN, N. Y.—The Kings County Electric Light & Power Company has applied to the Public Service Commission for permission to issue $5,000,000 in convertible debenture bonds.

BUFFALO, N. Y.—The Public Service Commission, Second District, has authorized the Buffalo General Electric Company to issue bonds to the amount of $420,000, to be sold at not less than 95, the proceeds to be used for the acquisition of certain property at the corner of Washington and Huron streets, in Buffalo, and for the erection of a building upon the same.

DUNDEE, N. Y.—E. L. Bailey, owner of the local electric-light plant, writes that the plant may supply electricity for three small adjoining towns at an early date. He also states that the property is for sale, as he is interested in other business. A day service is furnished for both lamps and motors.

EAST AURORA, N. Y.—The East Aurora Electric Light Company is comtemplating improvements to its system and establishing a day service, plans for which have not yet been completed. C. G. Persons is manager.

FONDA, N. Y.—The Cayadutta Generating Company is making arrangements to establish a day service, for which plans have not yet been completed. J. S. Wilson is treasurer and manager.

FULTON, N. Y.—The City Council has decided to grant the franchise for the distribution of electricity for lamps, heat and motors in Fulton, as applied for by the Oswego River Power Transmission Company, of Syracuse, N. Y., to be sold to the highest bidder. The Bureau of Public Works will place a minimum price for which the franchise is to be sold.

HERKIMER, N. Y.—It is reported that the City Council is contemplating extending the transmission lines of the municipal electric light system to North Ilion, N. Y., for the purpose of supplying electricity for lamps in that town. It is understood that application for a franchise will soon be made.

MOUNT MORRIS, N. Y.—Contracts have been awarded by the Livingston-Niagara Power Company for the construction of its main receiving station, to be erected at Golah, to the Alexander, Shumway & Utz Company, of Rochester, N. Y. The building will be 40 ft. x 30 ft., and will be equipped with transforming apparatus to change the current from 66,000 to 11,000 volts for transmission to Avon, Lima, Livonia, Honeoye Falls, Caledonia, Geneseo and other places in this vicinity.

NEW YORK, N. Y.—Sealed bids will be received by Kingsley L. Martin, Commissioner of Bridges, Department of Bridges, 13 to 21 Park Row, New York, N. Y., until March 9, for the installation of electrical equipment of the conduit tracks and the construction of the track extension on the Plaza extension of the Queensboro Bridge over the East River. Blanks, forms and specifications may be obtained at the above office.

OLEAN, N. Y.—The City Council has engaged Horace B. Sweet, of Utica, N. Y., to prepare plans and estimates for the construction of a municipal electric light plant.

LENOIR, N. C.—It is reported that the Lenoir Chair Company will equip its new factory for electric motor drive.

SMITHFIELD, N. C.—At an election held Feb. 21 the proposition to issue $55,000 in bonds, the proceeds to be used for the installation of water works, electric light plant and sewerage system, was carried. Gilbert White, of Durham, N. C., is engineer in charge of the work. H. L. Skinner is town clerk.

MINOT, N. D.—The Commercial Club is reported to be considering the question of installing an ornamental street-lighting system in the business district of the city.

MINOT, N. D.—Investigations are being made by Burns & McDonnell, of Kansas City, Mo., consulting engineers, with a view of establishing a municipal electric light plant in Minot.

OAKES, N. D.—A franchise is reported to have been granted to Ernest Marshall to install an electric-light plant in Oakes.

RUGBY, N. D.—Bids will be received at the office of Henry Albertson, county auditor, Rugby, N. D., for heating and ventilating, plumbing, electric wiring and conduits for the new Pierce County court house and jail until April 4. Plans and specifications are on file at the office of the county auditor and at the office of Buechner & Orth, architects, Shubert Building, St. Paul, Minn.

ALLIANCE, OHIO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 30, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building in Alliance, Ohio, in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site, Alliance, Ohio. James Knox Taylor is Supervising Architect.

COLUMBUS, OHIO.—Mayor George S. Marshall has recommended to the City Council that such action be taken as will enable the municipal electric-light plant to supply electricity for lamps at the rate of 5 cents per kw-hour. Mayor Marshall believes that a good profit may be obtained from the business rate and that the cost of operating the municipal plant may be reduced.

CONNEAUT, OHIO.—It is reported that the Nickel Plate Railroad is contemplating the construction of an electric-light plant to supply electricity for lighting the yards, offices, shops and roundhouse in Conneaut. At present the company secures electrical service from the municipal electric plant.

MANSFIELD, OHIO.—The City Council has adopted a resolution authorizing plans and estimates prepared for the construction of a municipal electric light plant. The cost of the proposed plant is estimated at from $100,000 to $175,000.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company has submitted a proposition to the city offering to supply electricity for commercial lighting at 8 cents per kw-hour instead of 10 cents per kw-hour, the present rate, and to reduce the price of arc lamps from $77.50 to $66 each per year. The reduction in the price of arc lamps means a saving to the city of $2,346 annually. The City Council has taken steps toward municipal ownership, having secured estimates of the cost of installing a plant in order that the question of a bond issue might be submiitted to a vote of the people.

DURANT, OKLA.—The City Council is reported to have adopted plans and specifications for the construction of a municipal electric light plant and has instructed the City Clerk to advertise for bids for same.

RAVIA, OKLA.—The Ravia Mining & Milling Company, recently incorporated with a capital stock of $100,000, is reported to be contemplating the installation of a power plant. E. W. Rose, of Dallas, Tex., is president and J. E. Harris, of Ravia, Okla., vice-president.

SENTINEL, OKLA.—At an election to be held early in March a proposition to issue $15,000 in bonds will be submitted to a vote. Of the proceeds of the bond issue, $3,000 will be used for extensions to the water-works system and $12,000 for the construction of a municipal electric light plant.

MEDFORD, ORE.—It is reported that Dr. J. F. Reddy will apply to the City Council for a franchise to construct and operate an interurban electric railway in Medford.

MEDFORD, ORE.—It is reported that the Rogue River Electric Company has practically decided to erect a power plant at Prospect. The proposed plant will have an output of 10,000 hp. C. R. Ray is president of the company.

PORTLAND, ORE.—Announcement has been made by the Portland Railway, Light & Power Company that contracts will soon be awarded for the construction of the third and the largest of the power plants on the Clackmas River. The proposed plant will be located about three miles above the present one and will cost about $3,000,000. B. S. Josselyn is president of the company.

PORTLAND, ORE.—Negotiations have been completed by the Washington-Oregon Corporation for taking over the plants and holdings of the Kalama Light & Power Company, of Kalama, Wash.; the Ranier Light & Power Company and the Kelso Light & Power Company, of Kelso, Wash. The company is planning to develop 10,000 hp at the Kalama plant, enlarging the present head of 40 ft. to 160 ft. and transmitting power to Kalama, Ranier, Kelso, Chehalis and Centralia, Wash., and a number of towns in Oregon. Work will begin at once on the erection of heavy transmission lines and other extensive improvements throughout southwestern Washington.

SALEM, ORE.—The Salem Board of Trade is reported to have authorized the executive committee to prepare plans for the installation of a cluster-lamp lighting system in this city.

PANAMA.—Bids will be received at the office of the Central Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until March 24 for furnishing rack railway material for the Panama canal locks, including rack, steel cross-ties, bolts and nuts, tie clips, washers, steel channels, copper conductor rails, steel conductor rails, insulators, bumpers, frogs, switches, etc. Blanks and general information may be obtained at the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ETNA, PA.—Sealed proposals will be received at the office of J. C. Armstrong, borough clerk, until March 13, for construction of power-house and furnishing equipment, including boilers and lamps, for the new borough light plant. Copies of plans and specifications may be obtained on application to the borough clerk.

MAUCH CHUNK, PA.—The Lehigh Coal & Navigation Company is contemplating establishing an electric light and power plant in Nesquehoning. The company proposes to utilize the waste culm washed away from the breakers for fuel.

POTTSTOWN, PA.—Steps have been taken with a view of establishing a municipal electric light and gas plant in Pottstown. Petitions have been circulated asking the Council to purchase the local plant of the Philadelphia Suburban Gas & Electric Light Company. It is proposed to have the Council and the company fix the price on the property, and in case of failure to have the court of Montgomery County appoint appraisers.

COLUMBIA, S. C.—The City Council is considering the question of establishing a municipal electric light plant, at a cost of about $40,000. A committee has been appointed to make investigations for same and report to the Council.

COLUMBIA, S. C.—A bill is now before the State Legislature asking for a charter for the Piedmont & Northern Railway Company, to be capitalized at $5,000,000. The charter provides for merging the Duke & Southern Power Company interurban interests on the South Carolina end of the line, including the Greenville, Spartanburg and Anderson Interurban Electric Railway, 100 miles in length, to the North Carolina line. The company proposes to operate electric railways between towns and to build street car lines in towns through which the main line may pass.

DEADWOOD, S. D.—The Nebraska Telephone Company is reported to be contemplating extensive improvements and extensions to its system in the Black Hills, involving an expenditure of $100,000, of which $85,000 will be spent for new work.

DRAPER, S. D.—It is reported that Dr. W. M. Hunt is planning to install an electric light plant this year.

ELLINGSON, S. D.—The question of erecting a telephone line to Grand River is reported to be under consideration.

HAYTI, S. D.—S. M. Ellis and J. A. Snyder, of Watertown, are reported to be contemplating the installation of an electric light plant in Hayti.

WESSINGTON, S. D.—C. E. Wright, of Wessington, S. D., is reported to have petitioned the Board of County Commissioners for a franchise to erect a telephone system in this county.

BIG SANDY, TENN.—The construction of a municipal electric light plant in Big Sandy is reported to be under consideration.

JACKSON, TENN.—The committee on street lighting has recommended the City Council to continue to operate the municipal electric-light plant. It is expected that the Council will adopt the report of the committee and that improvements will be made to the plant at once. The cost of rebuilding the plant is estimated at about $20,000. The Jackson Railway & Light Company submitted a proposition to the City Council offering to light the streets of the city for $9,000 per year. With the new plant, which will supply 150 street lamps, it is estimated that the street lamps can be maintained at a total cost of $6,000 per year.

BEAUMONT, TEX.—James F. Wood, receiver of the Beaumont Traction Company, is reported to have negotiated for the sale of $125,000 in receivers' certificates, the proceeds to be used for extensions and additions to the local street car lines.

BRYAN, TEX.—The Bryan-College Interurban Railway Company, which operates an electric railway between Bryan and College, has received authority from the State Railroad Commission to issue bonds to the amount of $72,000.

FLATONIA, TEX.—The Flatonia Ice, Water & Electric Light Company is installing an engine and other machinery in its plant.

GEORGETOWN, TEX.—Contracts have been awarded by the City Council for improvements to the municipal water and light plant, to cost about $35,000. The distributing system of the water works will be extended and new generators installed in the electric plant and other improvements made.

MILES, TEX.—S. M. Farmer and associates are reported to be contemplating rebuilding the local electric light plant recently destroyed by fire.

SAN ANTONIO, TEX.—J. A. Logwood, of San Antonio, and associates, who are constructing an electric interurban railway between San Antonio and San Jose, are reported to have sold the same to A. D. Powers, who it is said will complete the proposed railway.

SAN ANTONIO, TEX.—At a joint meeting of the directors of the San Antonio Gas & Electric and the San Antonio Traction companies, held recently, both of which are owned by the American Light & Traction Company, plans for improvements for both systems, involving an expenditure of $250,000, were adopted. It is understood that improvements to the electric-lighting department will cost $50,000, exclusive of the reconstruction and remodeling of the power plant at an additional cost of $35,000. Additional boilers and machinery will be installed in the gas plant and other improvements made at a cost of about $58,000. The San Antonio Traction Company will expend about $100,000 in double-tracking its lines and $50,000 for new electric cars.

WACO, TEX.—At an election held Feb. 14 the citizens voted to issue $250,000 in bonds, the proceeds to be used for the installation of a municipal electric-light and power plant. Plans will be prepared immediately for the proposed plant.

OGDEN, UTAH.—Plans and specifications are being prepared by the Merchants' Light & Power Company, which recently obtained a franchise from the City Council, for the erection of an electric power plant in Ogden. As yet it has not been decided whether a hydroelectric power or a steam plant will be installed.

SALT LAKE CITY, UTAH.—Initial steps have been taken by the City Council toward the installation of a municipal electric light plant. The city engineer has been instructed to furnish the Council with data concerning the city's facilities for installing such a plant, together with probable cost of same.

RICHMOND, VA.—The finance committee has recommended to the Council an appropriation of $9,000 for extension of the lighting system on Broad Street.

SMITHFIELD, VA.—The question of issuing bonds to the amount of $55,000, the proceeds to be used for the installation of a municipal electric light plant and sewerage system is reported to be under consideration.

WAVERLY, VA.—The local electric light plant has been purchased by A. H. Morfeld. It is understood that improvements will be made to the plant soon.

KELSO, WASH.—The Washington-Oregon Corporation, which has taken over the property of the Kelso Electric Company, is reported to be negotiating for the property of the Kalama Electric Light & Power Company. It is said that the company proposes to develop 8000 hp at the falls of the Kalama River, the erection of a transmission line to Centralia and Chehalis and also other improvements.

MARCUS, WASH.—The Marcus Commercial Club is reported to be considering the question of securing an electric light plant and waterworks system in Marcus. H. V. Gates is reported to be interested in the project.

TACOMA, WASH.—Bids will be received at the office of the Commissioner of Public Safety, City Hall, Tacoma, Wash., until March 9 for the following material: 5600 lb. No. 10 double-braid, weather-proof iron wire; 607 No. 9 pony insulators, 4 dozen rolls friction tape, 2000 ft. No. 14, rubber-covered copper wire, 300 3 x 4 storage battery couples, G. W. or B. T. type, five amp-hours capacity, 20 terminal plates, 10 positive and 10 negative, 100 2 x 7 x 4 double-groove battery jars, according to specifications on file in the office of the Commissioner of Public Safety. Bids must be made on printed form furnished by the commissioner.

BUNGERS, W. VA.—Plans are being prepared by S. S. Tuckwiller, of Lewisburg, W. Va., for the installation of an isolated electric plant to develop 12 kw, which will be transmitted from two to five miles to supply electricity to farmers and stockmen in this vicinity. The work will include the construction of a concrete dam, 100 ft. long and 4 ft. high; a 400-ft. conduit; 300 ft. 10-in. hydraulic pipe; water motor, with a rating of 25 hp.

WHEELING, W. VA.—It is reported that the Y. & O. Coal Company will erect a new power plant to replace the plant recently burned. It is said that the new power house will be located about half a mile above the old building.

CLIFTON (R. F. D. OAKDALE), WIS.—The State Railroad Commission has authorized the Clifton Light & Power Company to issue $200,000 in bonds, the proceeds to be used for the purpose of purchasing additional pole lines, right-of-way and real estate upon which to construct another dam in the town of Clifton and other work necessary in connection with the operation of a hydroelectric plant.

HORICON, WIS.—The Horicon Light & Power Company has been granted permission by the State Railroad Commission to issue $10,000 in bonds and 100 shares of capital stock of par value of $100. The entire issue of stocks and bonds, to an amount not to exceed $5,000, is to be issued to the Beaver Dam Light & Power Company in exchange for a transmission line constructed by it between Beaver Dam and Horicon and a substation and distributing system in Horicon; the balance to be sold for money only at not less than 80 per cent of their par value.

SPONNER, WIS.—The City Council has voted to purchase a site on the Namekagon River, on which it proposes to erect a power plant.

WATERLOO, WIS.—It is reported that bids have been called by the city clerk for the installation of an electric generator for the municipal electric light plant.

LUSK, WYO.—M. E. Shipley, of Hooper, Neb., has applied to the City Council for a franchise to install a telephone plant in Lusk.

CALGARY, ALTA., CAN.—The city has passed a by-law providing for an expenditure of $380,000 for extensions to the municipal electric-light plant and $60,000 for installation of underground conduit for electric wires.

CALGARY, ALTA., CAN.—Bids will be received by the City Commissioners until March 22 for machinery for the municipal electric-light plant, as follows: One 1500-kw turbo-generator set with condenser, etc.; one 100-kw exciter and switchboards, complete; three 1000-kva, single-phase transformfiers, 12,000-2300 volts, with switching gear, etc. W. D. Spence is city clerk.

EDMONTON, ALTA., CAN.—The Edmonton Heat & Power Company has submitted a proposition to the city offering to build an electric-light and power plant with an output of 20,000 hp and turn the same over to the city after three years for $3,000,000. It is said the offer is being considered as preferable to the city building a plant.

PINCHER CREEK, ALTA., CAN.—The by-law providing for the purchase of the local electric-light plant, owned by the Pincher Creek Brick, Light & Power Company, by the municipality was carried on Feb. 13.

VANCOUVER, B. C., CAN.—The City Council has authorized William M. Northcutt, purchasing agent, to call for bids soon for 300 iron lamp standards to be used in the extension of the cluster lamp lighting system.

ST. BONIFACE, MAN., CAN.—Terms and conditions have been decided upon by the City Council and the E. B. Reece Engineering Company, under which the company is to supply electricity for lamps, heat and motors in St. Boniface. The contract, which provides that the work shall be completed and power turned on by Nov. 1, 1911, will be executed as soon as the company deposits a check for $50,000 as an interim bond. Under the terms of the contract the company is to supply electricity on a sliding scale of rates, ranging from $18 to $15 per horsepower per year. An additional charge of $2 per horse-power per year will be made if the company installs a step-down transforming station. The contract is for a period of ten years, subject to renewals, and a revision of prices may be had every seven years, as provided in the Dominion water-power regulations. There is also a clause in the contract binding the company to meet any reductions which may be made by the City of Winnipeg, across the river, in its rates, to enable St. Boniface to compete for contract with companies that may wish to take power. The City of Winnipeg submitted a proposition to supply electricity at $18.50 per horse-power per year, at 2200 volts, thus eliminating the $2 charge, which the City of St. Boniface would have to pay in transforming energy purchased from either the Reece company or under the proposition submitted by J. D. McArthur on behalf of another company, both of which were declined.

OTTAWA, ONT., CAN.—Announcement has been made that the price for electricity supplied from the municipal plant for lamps will be reduced 19 per cent and rates for electricity for motors will be reduced from $25 to $23.50 per horsepower.

KRONAU, SASK., CAN.—The Kronau Rural Telephone Company, recently organized, will erect thirty-four miles of pole line at once. J. W. Irwin, of Kronau, Sask., is secretary and treasurer.

PRINCE ALBERT, SASK., CAN.—The Dominion government has signified its intention of granting the City of Prince Albert permission to develop the water power at Lacolle Falls on the Saskatchewan River. Arrangements will be made at once by the city for the construction of a 20,000-hp hydroelectric power plant. For further information address James McKay, of Prince Albert, Sask.

SALTSCOATS, SASK., CAN.—The Saltscoats Telephone Company has decided to sell its telephone system within the town limits to the Saskatchewan government. The company will retain control of the rural lines.

SOUTHERY, SASK, CAN.—The Buffalo Hill Rural Telephone Company, recently organized in Southery, is planning to erect fifteen miles of pole line at once.

SHERBROOKE, QUE., CAN.—The by-law authorizing the City Council to provide funds to the amount of $100,000 for the development of the Drop Off power, near Rock Forest, was carried. Ross & Holgate, of Montreal, Que., Can., are engineers.

GUANAJUATO, MEX.—The Providencia Mining & Milling Company is installing electrical equipment to operate its new ore-reduction mill and cyanide plant near Guanajuato. Forty motors will be installed, aggregating 600 hp.

PARRAL, CHIHUAHUA, MEX.—The Veta Colorado Mining & Milling Company has recently installed additional equipment in its plant, increasing the output of the plant to about 1500 hp.

SIERRA JUAREZ, OAXACA, MEX.—Plans are being made by the Compania Minera de Natividad y Anexa for the installation of a 1000-hp hydroelectric power plant at its mines near Sierra Juarez.

New Industrial Companies.

THE AMERICAN SMOKE FUEL COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $2,000 by A. D. Jones, Frank Dunn and C. B. Jones. The company proposes to develop patents on smoke-consuming machinery.

THE BRIGGS MANUFACTURING COMPANY, of Augusta, Maine, has filed articles of incorporation with a capital stock of $200,000 for the purpose of manufacturing magnetos, automobile and electrical supplies. R. S. Buzzell is president; M. M. Farrar, treasurer, and C. L. Andrews, clerk, all of Augusta, Maine.

THE ELECTRIC CURRENT CIGAR LIGHTER COMPANY, of Morristown, Tenn., has been chartered with a capital stock of $5,000 to manufacture cigar lighters. The officers are: T. S. Myers, president; C. M. Cain, vice-president; Herbert Jarnagin, secretary and treasurer, and S. P. Harris, general manager.

THE HYDRO CONSTRUCTION COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $25,000 by H. M. Gall, H. M. Cowper and H. W. Cowper, all of Buffalo, N. Y. The company proposes to do a general contracting and engineering business.

THE KNOX TEREZONE COMPANY, of Elizabeth, N. J., has been chartered with a capital stock of $250,000 by J. W. Knox, L. H. Rogers and W. A. Sherman, of Elizabeth. The company proposes to manufacture generators, equip hospitals with ventilating and heating appliances, etc.

THE MARCO ELECTRIC MANUFACTURING COMPANY, of Boston, Mass., has filed articles of incorporation with a capital stock of $25,000 to manufacture and deal in electrical machinery. A. H. Martin, of West Roxbury, Mass., is president and treasurer.

THE MELLEN CONSTRUCTION COMPANY, of Portland, Maine, has been incorporated with a capital stock of $50,000 for the purpose of manufacturing water wheels and machinery of all kinds. E. T. Fenley is president and H. L. Cram, treasurer and clerk, both of Portland, Maine.

THE POWER CONSERVATION COMPANY, of New York, N. Y., has been incorporated by M. M. Bamberger, F. L. Page and C. H. Meader, all of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture engines, machinery, etc.

THE SAUER MOTOR COMPANY, of Rainfield, N. J. (not a post office), has been incorporated with a capital stock of $1,600,000 by D. W. Yeckley, of Arlington, N. J.; H. B. Banken, of Port Washington, N. Y., and C. S. Fallows, of New York, N. Y. The company proposes to manufacture motors, engines, machines, etc.

THE WALKER-MIDDLEBROOK COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $15,000 to deal in electrical equipment. The officers are: J. M. Middlebrook, president and general manager; W. M. Mays, vice-president, and J. B. Danforth, secretary and treasurer.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Sierra Nevada Water & Power Company with a capital stock of $25,000 by C. A. Wright, Frank Smith and E. McGettigan. The company proposes to own water rights, construct reservoirs, canals, flumes, etc., and to generate and sell electricity for lamps and motors.

SONORA, CAL.—Articles of incorporation have been filed for the Yosemite Power Company with a capital stock of $10,000,000. The directors are: Albert Raymond, Lester B. Wiley and John C. Hayes.

DOVER, DEL.—The Wyoming Electric Company has filed articles of incorporation with a capital stock of $25,000. The incorporators are: H. K. Berry, F. T. Herbert, of Wyoming, and A. M. Daly, of Dover, Del.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company has been incorporated to construct an electric railway from New Iberia to Lafayette, a distance of seventy-five miles. Other lines from Morgan City to Jeanerette may also be built. It is understood that financial arrangements have been made for construction of the proposed railway and that surveys will begin within a few weeks. F. W. Crosby, of New Orleans, La., is president.

FORT KENT, MAINE.—The Fort Kent Electric Company has been organized with a capital stock of $50,000 for the purpose of generating and supplying electricity in Fort Kent. The officers are: Alexis O. Robbins, of Fort Kent, president, and Edna M. Rollins, of Lincoln, Maine, treasurer.

LIBBY, MONT.—The Milwaukee Electric Power Company has filed articles of incorporation for the purpose of developing the water power on Yahk River in the western part of Lincoln County. The company, it is said, has secured a site on the Yahk River, where it will erect a power plant and supply electricity to the mines in that locality, including the Sylvanite mines.

MONROE, N. C.—The Monroe Telephone Company has been incorporated with a capital stock of $125,000 by W. H. Black, George S. Lee and others.

BRITTON, OKLA.—The Britton Telephone Company has been incorporated with a capital stock of $3,000 by G. E. Crawford, S. S. Shintaffer, E. S. Rose and others.

MUSTANG, OKLA.—Articles of incorporation have been filed for the Mustang Telephone Company with a capital stock of $1,500 by C. H. Mahr, R. L. Brownlee and others. The company proposes to erect rural telephone lines.

Personal.

MR. OSCAR H. PERKINS has resigned from the Stuart-Howland Company, Boston, in order to rejoin the Westmore-Savage Company, of the same city.

MR. EDWARD B. ELLICOTT, electrical engineer of the Sanitary District of Chicago, has been re-elected to this position by the new board of trustees, a portion of which was chosen at the last general election.

MR. RICHARD WILDER, of Evansville, Ind., has been appointed manager for the Central Union Telephone Company to succeed Mr. G. C. Treadway, who becomes commercial agent for the same company at Peoria, Ill.

MR. J. H. SCHUMACHER, electrical engineer, for several years with the Chas. L. Pillsbury Company, consulting engineer, of Minneapolis and St. Paul, has resigned from that company to take up the management of the Mitchell-Gray Electric Company, at Winnipeg.

MR. JOSEPH BUEHLER has, owing to recent bereavements, retired from the firm of Hatzel & Buehler, electrical engineers and contractors, New York, after a partnership extending over twenty-one years. Mr. John C. Hatzel will continue the business under the firm name as heretofore.

MR. W. R. PUTNAM, whose resignation as superintendent of the Menominee & Marinette Light & Traction Company was recently announced, has been appointed electrical engineer of the Dakota Power Company, Rapid City, S. D., in charge of the construction of the hydroelectric plants of the company on the Rapid River.

MR. F. A. KETCHAM, acting manager for the Western Electric Company in Chicago, has been appointed chairman of Subdivision Committee No. 31 of the Chicago Association of Commerce. This committee is made up of men interested in the sale of electrical goods, and Mr. Ketcham succeeds Mr. Thomas I. Stacey, who has resigned.

MR. T. F. HOLMGREN, the well-known Swedish electrical engineer and general manager of the Royal Trollhättan Power System, is on a visit to this country in order to inspect some of our more important hydroelectric transmission systems. Mr. Holmgren is accompanied by Mr. Knut W. Bildt, electrical engineer of a large mining company in Lapland.

MR. W. W. FREEMAN, president of the National Electric Light Association, is to address the local section of the Toronto Electric Light Company on March 24. It will be remembered that Mr. Freeman is a Canadian. The Toronto section is large and growing rapidly, while there are vigorous National Electric Light Association sections also in Montreal and Vancouver.

MR. W. K. BIXBY has been elected president of the Laclede Gas-Light Company, of St. Louis, which distributes electrical energy purchased from the Union Electric Light & Power Company. Mr. Charles L. Holman, vice-president and general manager of the company, will be retained in his present capacity. Mr. John I. Beggs was the last president of the Laclede company.

MR. JAMES R. CRAVATH, of Chicago, will receive the sincere sympathy of his friends on the occasion of the death of his mother, long a highly esteemed resident of Grinnell, Iowa, where she died on Feb. 25. As Western editor of the *Electrical World* for a number of years and now as a practising engineer and special contributor to this journal, Mr. Cravath has a wide circle of friends and acquaintances, who will extend their condolences.

MR. F. H. ENSIGN has resigned as manager of the Pacific Gas & Electric Company, Phœnix, Ariz., in order to devote his time to personal interests. He will assume the management of the New State Electric Supply & Fixture Company and the New State Auto Aerial Company, in which he is financially interested. His successor as manager of the Pacific company will be Mr. R. G. Whitmark. Mr. Ensign will continue to serve as consulting engineer for this company.

MR. F. P. CATCHINGS, who has for the past ten years been electrical engineer of the North Georgia Electric Company and the Etowah Power Company, has been appointed manager of the Georgia Power Company at Atlanta, Ga., which is a consolidation and reorganization of the old companies. The Georgia Power Company is now engaged in building a 100,000 hp plant at Tallulah Falls, Ga., the Northern Contracting Company being the constructor.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, of Chicago, who is a great traveler, has been interviewed in Paris and is reported to have said that, while he sees many things to admire in London and Paris, Chicago is not, after all, so bad by comparison. Europe tolerates many abuses, he says, because they are the custom. In American cities a similar reverence for tradition does not obtain and therefore these old crusted inconveniences do not exist.

MR. LEONARD J. BOTTING, secretary of the Central Station Development Company, has been appointed general manager, succeeding Mr. W. H. Wissing, the rapid growth of the company having necessitated a division of the duties of vice-president and general manager, which have hitherto been assumed by Mr. Wissing. Mr. Wissing will concentrate his energies largely upon the investigation of successful central-station methods throughout the country and the collection of information and data pertaining to the results accomplished under various conditions.

MR. CHARLES F. GRAY, for four years past superintendent of construction for the Canadian Westinghouse Company, with headquarters at Hamilton, Ontario, has been transferred to the Winnipeg office of the above company to take charge as chief engineer of the Canadian Westinghouse Company's construction staff, erecting switching and transforming apparatus at the City of Winnipeg's 60,000 hp hydroelectric plant at Point du Bois, Manitoba, and the terminal station and substations in the City of Winnipeg. Mr. Gray's headquarters will be in the Westinghouse Building, Winnipeg.

MR. M. S. ALLEN, who has been in charge of the telephone sale department of the Western Electric Company's Atlanta house for three years, has been appointed manager of the Omaha house of the same company. Mr. Allen was connected with the Rocky Mountain Bell Telephone Company for ten years, entering the employ of the Western Electric as manager of its Salt Lake City house in 1905. A year later he became manager of the San Francisco house, from which he was transferred to Atlanta in 1908. While in the South Mr. Allen has been closely identified with the spread of the rural telephone movement in that section.

MR. HENRY FLOY has recently purchased from the estate of the late Mr. William H. Bryan, of St. Louis, the complete collection of data and references on the subject of depreciation gathered by Mr. Bryan. This collection is the result of years of work of Mr. Bryan and his assistants. Mr. Bryan's experience in making appraisals and valuations made him a recognized authority on questions of depreciation. His paper "The Appraisal and Depreciation of Water Works and Similar Properties," read before the Engineers' Club of St. Louis about three years ago, is recognized as a classic on the subject. The collection purchased by Mr. Floy includes duplicates of the references collected by the American Water Works Association committee on depreciation, in addition to similar data on electric railway and lighting plants, water-power plants, telephone systems, etc. The addition of Mr. Bryan's collection to Mr. Floy's data makes an unusually extensive and authoritative reference library on depreciation.

MR. JOHN I. BEGGS, president of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., announced his retirement from the presidency of that company last week. Mr. Beggs will remove about April 1 to St. Louis, where he will take charge of the St. Louis Car Company, of which he will become president and general manager. Mr. Beggs has been identified with the management of public-service corporations for many years and is recognized as one of the leading and most forceful men in the electric railway and electric lighting industries. He is no stranger to manufacturing and selling enterprises, for twenty years ago he was Western manager for the old Edison General Electric Company. Since then he has been connected with electric lighting or electric railway companies in Cincinnati, St. Louis and Milwaukee. He took full charge of the predecessor of the present Milwaukee Electric Railway & Light Company in 1897. The property had then just emerged from bankruptcy, but Mr. Beggs has built it up until it is now recognized as one of the most prominent and successful of the combined central-station and electric-railway companies of the country. Mr. Beggs has been president of the American Electric Railway Association and is a man of varied and extensive interests. The St. Louis Car Company is at present one of the largest car-building concerns in the country and Mr. Beggs is reported to have acquired a controlling interest in it. The retiring president of the Milwaukee company is a man of remarkable versatility and of unshrinking courage. President James Campbell, of the North American Company, of New York, which is interested in the Milwaukee Electric Railway & Light Company, says that Mr. Beggs retires from the management of the Milwaukee company against the wishes of every one interested. He paid this tribute to the retiring president: "Mr. Beggs is an ideal executive of a great company. He is a wonderful executive; he has vision; he not only can tell others how to do things, he can do them himself. I never have known a man who combined so many qualities of leadership. He is an engineer, an administrator, an accountant and a financier. The Milwaukee Electric Railway & Light Company is a monument to his ability as a manager and his devotion to duty as a man." Mr. Beggs became connected with the electrical industry in its early days, being manager of an electric-lighting plant in Harrisburg, Pa., in 1884. After that he became connected with the Edison Company, as stated. While retiring from the management of the Milwaukee property, Mr. Beggs will retain his financial interest in the company and remain as one of the directors. His removal to St. Louis is no doubt influenced by other than business reasons, for that city is the home of his daughter and grandson and his family ties are there.

JOHN I. BEGGS.

Obituary.

MR. J. McM. SMITH, the traction expert, first general manager of the Elkhart-South Bend Line, died in South Bend, Ind., February 6, as the result of a nervous breakdown. When stricken several weeks ago he had just accepted the position of general manager of the Fort Wayne-Kendallville traction line. Mr. Smith was born in Tennessee in 1853 and after an early career as telegrapher he served twenty years as private secretary to George M. Pullman, of the Pullman Car Company. About twelve years ago he became active as a traction promoter in northern Indiana, and it was he who induced Arthur Kennedy and D. C. Dilworth, of Pittsburgh, to take hold of the then projected Elkhart-South Bend line, from which the Northern Indiana System has developed. The Dilworth interests were acquired by the Kennedy and Murdock syndicate, which then bought Mr. Kennedy's interests. Soon after this Mr. Smith's resignation was submitted and he became manager of the South Bend and St. Joseph line, which later was absorbed by the Murdocks.

Trade Publications.

ARC LAMPS.—The Western Electric Company is distributing Bulletin No. 5500, relating to direct-current and alternating-current inclosed-arc lamps, designed for both outdoor and indoor service.

EXCITER SWITCHBOARDS.—Switchboards intended especially for use with exciter generators employed in connection with alternators are described in Bulletin No. 4782 of the General Electric Company.

SWITCHBOARD WATT-HOUR METERS.—The Machado & Roller Company, Pittsburgh, Pa., has issued a well-illustrated booklet devoted to Columbia shunted astatic watt-hour meters designed for switchboard mounting.

VOLTAGE REGULATORS.—Bulletin No. 4602B of the General Electric Company, Schenectady, N. Y., contains complete wiring diagrams and engineering descriptions of automatic voltage regulators for direct-current generators.

WIRE ROPE.—A. Leschen & Sons Rope Company, 920 North First Street, St. Louis, Mo., has issued a strikingly illustrated catalogue covering wire rope and aerial wire rope tramways. The illustrations relate to numerous installations in which wire rope is employed.

ADJUSTABLE-SPEED MOTORS.—The Reliance Electric & Engineering Company, 312 Huron Road, Cleveland, Ohio, is distributing an illustrated mailing folder giving in condensed form much information concerning adjustable-speed motors for use with machine tools.

PLANT TESTING.—In a booklet entitled "Economical Power Plant Operation," the Richard D. Kimball Company, 437 Fifth Avenue, New York, describes in detail the various economies that can be effected in the operation of power plants in the proper as compared with the improper manner.

TELEPHONE SWITCHBOARD.—Bulletin No. 1014 of the Western Electric Company contains much detailed information relating to central-battery non-multiple switchboards with magnetic signals. These switchboards are used in exchanges where the ultimate number of lines will not exceed 500.

INCANDESCENT LAMPS FOR STREET LIGHTING.—High-efficiency metallic-filament lamps designed particularly for street lighting service are fully described in Bulletin No. 4781 of the General Electric Company, which contains many valuable data relating to the cost of operating lamps of this type.

RECORDING THERMOMETERS.—Bulletin No. 127 of the Bristol Company, Waterbury, Conn., is a 40-page publication dealing with recording thermometers designed for temperatures between 60 deg. below zero and 800 deg. Fahr. Detailed descriptions are given of the thermometers suitable for use under various conditions considered.

THREE-WIRE GENERATORS.—Direct-current generators in which 125 volts and 250 volts are produced simultaneously in one machine are described fully in Bulletin No. 441 of the Triumph Electric Company. The neutral point of the three-wire system is obtained by means of three transformer balancing coils connected to three collector rings joined to appropriate points on the armature winding.

BUSINESS NOTES.

THE AMERICAN CONDUIT & MANUFACTURING COMPANY has appointed Mr. Milton Mill, 915 Olive Street, St. Louis, as Southwestern agent for its products.

THE ASBESTOS PROTECTED METAL COMPANY, Canton, Mass., has established a Western office at 613 Fisher Building, Chicago. Mr. Wilmot W. Burritt is in charge of this office and territory as district manager.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY, Cleveland, has moved into its new plant at Collinwood Station, near Cleveland. The mail address to Cleveland should, for prompt delivery, include "Collinwood Station."

MR. GEORGE A. JOHNSTON, of Los Angeles, Cal., has moved his office to 551 South Los Angeles Street, where he will continue to act as sub-agent for Wagner line of alternating-current motors, generators, transformers and instruments.

NEW COOPER HEWITT WORKS.—The new works of the Cooper Hewitt Electric Company, Eighth and Grand Streets, Hoboken, N. J., have been completed. The general offices have been removed to the works from 220 West Twenty-ninth Street, New York.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, of Chicago, has opened a branch store at 25 Jackson Boulevard. (By a new system of street numbering this store will be 62 East Jackson Boulevard after April 1.) A full line of electrical supplies for the retail trade will be carried at the new location, which is in a section of smart shops.

THE UNION ENGINEERING COMPANY has been organized with offices at Columbia, S. C., in order to conduct the business of designing and installing lighting, power and water plants. The staff of the company includes well-qualified electrical and mechanical engineers, with Mr. J. M. O'Brien as managing engineer. The field of work extends to the several neighboring states.

THE HEMMING MANUFACTURING COMPANY has had to double the capacity of its plant, the additions having just been completed. The company has moved its main office to the factory at Garfield, N. J., but the sales office still remains at 2 Rector Street, New York, in charge of Sales Manager Butler Keys, who will as well look after the interests of the company in New York City.

BETTS & BETTS.—In our issue for January 5, on page 55, appeared a description of a large industrial electric sign being built for the Edison Electric Illuminating Company of Boston, Betts & Betts, of New York, being credited with its building. Our attention has been called by this firm to the fact that it merely furnished the flasher and the color caps for the sign, which was built by the Federal Sign System Electric, of New York. The firm of Betts & Betts has discontinued manufacturing electric signs and devotes its entire time to flashers, color caps and electrical specialties for the use of sign manufacturers.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, has found it necessary to work a night shift three nights a week in order to keep pace with orders. Among recent sales have been thirty-eight induction motors in sizes up to 50-hp to Bishop & Babcock, ten induction motors of various sizes to the Davis Knitting Mills, one 150-hp induction motor to H. T. Lloyd, Spokane, and twenty-five direct-current motors to the American Window Glass Company. Generator sales include three 75-kw, one 100-kw and one 50-kw direct-connected generator, three 50-kva belted alternators and one 35-kva motor generator set.

THE VALENTINE-CLARK COMPANY, of 1001 McCormick Building, Chicago, will on March 15 remove its general offices to 932 Security Bank Building, Minneapolis, Minn. The above company for twenty years has been identified with the cedar trade in Chicago and, recognizing that the successful operation of any business depends greatly on the producing end, is making this change in order that it may be in closer touch with its woods operations. Cedar is practically cleaned out of Michigan and certain portions of Wisconsin, and it is estimated that in the future 90 per cent of the poles, ties and posts will be produced in upper Minnesota and in the West. The company has a large yard at Minnesota Transfer, Minn., where a plant for the treatment of cedar poles with C. A. wood preserver is located, which is to be extended, thus necessitating closer personal attention than in the past. The company will also carry at this yard quantities of Western cedar produced in its own operations at St. Maries, Idaho. It is the intention of the company to increase not only its Minnesota but its Idaho operations. Northern white cedar poles will be carried in large quantities as usual at the company's Prentice and Green Bay (Wis.) yards—the latter yard being particularly well located for Eastern shipments.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April or May, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting Chicago, November, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary N. T. Wilcox, Lowell, Mass.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allen H. Royce, 48 King St. West, Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Acting Secretary F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York.

ELECTRIC CLUB, CHICAGO. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, C. H. Lembower, Reading, Pa.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, Herbert Silvester, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn. Annual meeting, St. Paul, Minn., March 14, 15 and 16, 1911.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Next meeting, St. Louis, April 13-15, 1911.

NATIONAL ARM, PIT & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Pittsburg, June 6-8, 1911.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary Joseph B. Ware, Grand Rapids, Mich.

NEBRASKA ELECTRICAL ASSOCIATION. -Secretary Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Henry M. Stille, Harrisburg, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY, Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings, fourth Monday of each month.

RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. President, A. C. Moore, Safety Car Heating & Lighting Co., Chicago.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex. Annual convention, Houston, Tex., April 27-29, 1911.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 21, 1911.

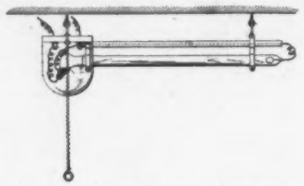
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

984,534. MULTIPLE ELECTRIC LIGHT SWITCH; G. D. Brookins and J. C. Vetter, Cleveland, Ohio. App. filed April 21, 1910. Rotary snap switch, one member cone shaped and carrying a contact strip and the other member cupped to receive the cone and carrying a plurality of circularly adjustable contacts.

984,547. CENTRAL ENERGY TELEPHONE SYSTEM; F. W. Dunbar, Chicago, Ill. App. filed March 22, 1901. The circuit for energizing the relay comprehends a portion of the talking circuit with return through a third conductor.

984,558. MOUTHPIECE FOR SOUND TRANSMITTERS; J. Graham, Philadelphia, Pa. App. filed April 22, 1910. A removable cup-shaped mouthpiece for telephones and a carrier for attaching the mouthpiece to the transmitter, the mouthpiece being destroyed when removed from the carrier.

984,559. LIGHTNING ARRESTER; E. R. Harding, Chicago, Ill. App. filed July 5, 1907. Two parallel coils of wire with a cylindrical length of carbon between the coils in proximity to the convolutions the carbon being adjustable endwise and longer than the coils and rotatable relatively thereto.



984,707.—Vapor Electric Apparatus.

984,561. LAMP RECEPTACLE AND HOLDING MEANS THEREFOR; H. T. Hochhausen, Brooklyn, N. Y. App. filed July 25, 1907. An apertured plate with lamp receptacle in the plate having a plurality of openings, a grooved hub on the receptacle and a clamp ring engaging the grooved hub with an inturned end projecting through the plate and engaging in one of the openings in the receptacle to lock the latter against rotation.

984,582. ALTERNATING-CURRENT MOTOR; B. McCollum, Lawrence, Kan. App. filed Dec. 22, 1909. Inductive motor of the squirrel-cage type with a short-circuiting ring of tungsten steel forming part of the circuit of the motor.

984,590. PROCESS OF PURIFYING AND REFINING IRON; J. B. Nau, New York, N. Y. App. filed Sept. 16, 1909. Refining pig iron in an electrical furnace by immersing the lighter ore in the heavier liquid iron and heating the partially refined iron with an electric current.

984,605. METHOD OF PRODUCING NITROGEN AND CARBON DIOXIDE FROM GASEOUS PRODUCTS OF COMBUSTION; M. Reichel & H. Braun, Berlin, Germany. App. filed Sept. 8, 1909.

984,651. CONTROL SYSTEM FOR ELECTRIC MOTORS; A. C. Eastwood and J. F. Schnabel, Cleveland, Ohio. App. filed March 18, 1910. A motor with field and armature and two resistances, the armature and field being in parallel circuits and connected in a dynamic breaking circuit for low speeds, resistance being inserted in the field circuit, cut out of the armature circuit and then inserted in the dynamic-breaking circuit for higher speeds.

984,655. COMMUTATOR; F. C. Fischer, Philadelphia, Pa. App. filed Sept. 8, 1910. Forms a mechanical incision of variable shape in a defective part of the commutator bar and then puts in a plug and secures it in position.

984,673. CLOTHES-PRESSING TOOL; T. M. House, Weldon, N. C. App. filed Jan. 12, 1910. Pivotally connected hand levers with opposing pressing heads carried by the outer ends of the levers, a pivot connecting one of the heads to its lever and a spring bearing against the pivotally mounted head and carried by the lever which supports the head with means for electrically heating one of the heads.

984,915.—Diaphragm Construction.

984,677. PLAYING APPARATUS FOR PIANOS AND OTHER MUSICAL INSTRUMENTS; J. F. Kelly, Pittsfield, Mass. App. filed May 14, 1908. A plurality of rotating friction drums with different surface velocities, with friction surfaces connected to operate the tone-producing device and thrown into engagement with the drum by electrical means.

984,679. AUTOMATIC ADJUSTABLE HOLDER FOR TELEPHONE RECEIVERS; S. O. Lancaster, London, Ont., Can. App. filed March 14, 1910. Stand for telephones with pivoted arms having clasps to hold the receiver, the arms being secured to the telephone stand.

984,686. INTERCOMMUNICATING TELEPHONE SYSTEM; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. Common battery system with indicating keys for the parties and their bells and for cutting off ringing current and switching on talking current. The keys assume three positions, the lowest position closing a master contact, the intermediate position establishing talking and the third position being the disconnected position.

984,703. PROCESS OF MAKING SULPHURIC ACID AND ELECTROLYTIC IRON; A. S. Ramage, Detroit, Mich. App. filed Jan. 9, 1909. Dissolves the ferric ore in sulphuric acid and reduces to ferrous sulphate the sulphur dioxide and electrolyzes by means of an insoluble anode and depolarizes the anode.

984,707. VAPOR ELECTRIC APPARATUS; M. von Recklinghausen, New York, N. Y. App. filed Nov. 10, 1903. A horizontal bar to which the lamp is clamped and in which clamps the lamp may be rotated, for giving it the shock for starting, when lamp has to be mounted on ceiling with limited space.

984,712. TROLLEY RESTORER; W. H. Stebbins, Jr., Buffalo, N. Y. App. filed Jan. 14, 1910. Trolley restoring member with arms on opposite sides of the trolley wheel pivoted to the upper end of the trolley pole with piston connection to the restoring member operated by compressed air.

984,719. METHOD OF ELECTRIC WELDING; E. Thomson, Swampscott, Mass. App. filed July 10, 1909. Fixes the two pieces together, wedges in a piece of metal and passes an electric current through the joint.

984,726. VACUUM TUBE; W. A. Winter, New York, N. Y., and C. M. Peabody, South Orange, N. J. App. filed April 14, 1910. Has a conducting element on one surface to hold the charge, a second element on the other surface of the tube, a terminal passing through the tube and carried by one of the elements and a terminal connected to the other element so as to provide a path for static discharges.

984,738. ANTI-INDUCTION APPARATUS FOR TELEPHONE SYSTEMS; A. Barrett and W. Condon, Kansas City, Mo. App. filed Dec. 28, 1908. A main circuit with two branches inductively related to each other, but not to the main circuit, the main circuit intermediate the branches having low resistance to all currents and a telephone receiver in one of the branches.

984,748. ELECTROMAGNETIC APPARATUS; J. P. Coleman, New York, N. Y. App. filed Nov. 2, 1910. For operating a pin valve of a pneumatic signaling apparatus by means of an alternating-current electromagnet, including an energizing coil, two pivoted armatures, with two paths for magnetic flux therethrough, one operating to move the armature and the other to hold it closed.

984,759. SWITCH AND FUSE SUPPORT AND COVER; W. J. Gibbons, Philadelphia, Pa. App. filed July 2, 1910. A base with electrical connections carrying a cover having cavities into which the connections extend when the cover is in place with a separating wall between the cavities.

984,760. PROCESS FOR PRODUCING ARTICLES BY ELECTRODEPOSITION; F. I. Gibbs, Birmingham, England. App. filed Sept. 23, 1909. Electrically deposits metal on a glazed metallic luster surface of pottery ware and then removes the model.

984,762. APPARATUS FOR RECEIVING ELECTROMAGNETIC WAVES; F. A. Hart, New York, N. Y. App. filed May 6, 1910. Syntonic receiver which may be used for receiving with group frequency waves by means of an arrangement of ballast and selective circuits and non-inductive resistances for eliminating undesired wave lengths, there being two alternative paths to earth from the antenna, one path consisting of an inductance and a capacity and the other of a capacity and two inductances, with a portion in parallel.

984,767. AUTOMATIC TROLLEY POLE; J. W. Lang, Los Angeles, Cal. App. filed Aug. 11, 1909. Pneumatic means for moving the pole controlled by a valve, which is controlled by a hydraulic device or dashpot with restricted passageway to cause the pole to follow the wire in ordinary operation and to act upon the pneumatic device to drop the pole on a quick jump of the wheel.

984,769. ELECTROCHEMICAL PRODUCTION OF PHOSPHATIC FERTILIZERS; G. Levi, Rome, Italy. App. filed Aug. 14, 1909. Heats certain phosphates in an electric furnace.

984,771. OUTLET BOX; N. Marshall, Newton, Mass. App. filed June 1, 1909. An outlet box with insulating base, carrying conductor bars providing four pairs of attaching devices, the conductors crossing each other at right angles, and having their ends separated by radial ribs extending from the center of the base.

984,842. APPARATUS FOR OBTAINING PRECIOUS METALS; J. R. Parks, Spokane, Wash. App. filed June 24, 1907. A plurality of extraction pans supported at different levels, the liquid flowing through the pans in succession and being subjected to electrolysis while in the pans, each pan being removable for cleaning without intererupting the flow of liquid through the remaining pans.

984,851. FORGING MACHINE; C. E. Reed, Chicago, Ill. App. filed Sept. 24, 1910. The blank is placed between forming dies which constitute electrodes to supply current to heat the blank.

984,902. PULL SWITCH; G. W. Goodridge ,Bridgeport Conn, App. filed Dec. 14, 1910. To prevent loosening of the end ball of the chain by means of a spring which holds the end ball in its socket.

984,905. PROCESS AND APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; J. Greenwood, London, England. App. filed Nov. 22, 1909. Causes the liquor to pass through a series of superimposed and concentric cells, each comprising a hollow anode andl a cathode, and regulates the flow of liquor into the first hollow anode and through the apparatus in accordance with the current density.

984,915. DIAPHRAGM CONSTRUCTION; W. S. Heltzen, Davis, W. Va. App. filed May 19, 1910. Diaphragms for cathodes impervious to liquid, but permitting soda to pass through, consisting of a composition of cement and ground asbestos fibre placed on asbestos cloth, which cloth is heated and the resulting diaphragm hardened by silicate of soda.

984,925. PROCESS OF OXIDIZING NITROGEN OF AIR BY MEANS OF ELECTRIC DISCHARGES; K. Kaiser, Wilmersdorf, near Berlin, Germany. App. filed March 25, 1910. Adds ammonia to oxygen and nitrogen and subjects the mixture to an electric discharge.

984,945. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed Nov. 13, 1909. A telephone system with metallic line circuit, a plurality of windings bridged across the metallic circuit, magneto ringer for each winding, connected between the return circuit and the associated winding, and a telephone talking set bridged across the ringer.

984,958. TELEPHONE EXCHANGE SYSTEM; J. G. Mitchell, Cleveland, Ohio. App. filed July 15, 1909. Telephone exchange system with operators' positions and trunk line, inductive terminal at the second position, and also a self-locking signal passable for alternating ringing current only, the inductive terminal being disconnected and the signal unlocked by the operator.